SYCLOPS

Deliverable 1.1 – Project Management Quality and Risk Plan

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D1.1 – Project Management, Quality, and Risk Plan

Executive Summary: D1.1 describes mechanisms to be used during the project implementation, in order to ensure high quality of activities and deliverables.

WP: WP1 Project Management

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Leading Partner: EURECOM

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Disclaimer

The SYCLOPS consortium consists of the following partners:

No.	Partner Organization Full Name	Partner Organization Short Name	Country
1	EURECOM GIE	EUR	FR
2	INESC ID - INSTITUTO DE ENGENHARIADE SISTEMAS E COMPUTADORES, INVESTIGACAO E DESENVOLVIMENTO EM LISBOA	INESC	PT
3	RUPRECHT-KARLS-UNIVERSITAET HEIDELBERG	UHEI	DE
4	ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE	CERN	CH
5	HIRO MICRODATACENTERS B.V.	HIRO	NL
6	ACCELOM	ACC	FR
7	CODASIP S R O	CSIP	CZ
8	CODEPLAY SOFTWARE LIMITED	CPLAY	UK

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Statement of Originality

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

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List of Terms and Abbreviations

Abbreviation	Description
WP	Work Package
RPN	Risk Priority Number
EFMEA	Expanded Failure Modes and Effects Analysis
PC	Project Coordinator
PO	Project Officer
GA	General Assembly
QP	Quality Plan
QCB	Quality Control Board
EAB	External Advisory Board

Executive Summary

SYCLOPS Deliverable D1.1 (“Project Management, Quality and Risk Plan”) presents the main processes of the project, including project day-to-day activities, agreed procedures and templates, as well as the project quality management process, risk assessment and contingency planning.

The Deliverable is structured into four main sections:

- First section “Project management plan” describes the Project legal basis, its goals, as well as the consortium partners, work allocation, and the main contact points. This section also details main project processes (e.g., schedule, deadlines, management boards etc.), meetings, as well as communications (e.g., including communication among partners and the European Commission)
- Second section “Quality Plan” covers policies and procedures for assessing the progress of the work within SYCLOPS, along with corrective actions and contingency planning in case of deviations; with the aim of ensuring that the consortium members act in a coordinated way and that necessary quality levels are met.
- Third section “Risk Assessment & Contingency Plans” describes the methodology selected (EFMEA), introducing variables such as Severity (S), Occurrence (O), Detectability (D) and Recoverability (R) for each risk. Detailed tables are presented containing the identified risks, classified into categories. Mitigation plans are defined for the risks identified and a total risk estimate is calculated for the entire project. The results of risk analysis indicate that SYCLOPS is not a risky project.

The Deliverable includes the following Annexes:

- Annex A “SYCLOPS List of contacts” provides a list of points of contact for each partner organisation with the email addresses.

1 Introduction

The main aim of this deliverable (D1.1 Project Management, Quality and Risk Plan) is to elaborate in detail all aspects of the SYCLOPS Project as approved: Description of Work Packages, Tasks and Deliverables, Financial Management, Management and Quality Plan, Risk Assessment & Contingency Plans, Internal and External Communication Strategy. The Deliverable will also include management tools and guidelines to be used during Project's implementation.

In addition, the document provides a detailed allocation of tasks, responsibilities, and timescales, as well as an overview of the project phases, internal communication structures to guarantee smooth and efficient management of the project. At the same time, it describes the mechanisms used during the project implementation to ensure high quality of project deliverables, activities, and on how to manage project risks and challenges.

The first part of this deliverable (Chapter 2) includes the detailed Project Plan, which defines:

- Roles and responsibilities of the partners
- Project Management bodies
- Procedures to be carried out among partners in exchanging information
- Clear Guidelines on how to perform the daily project management activities

The second part of this deliverable (chapter 3 and 4) constitutes the SYCLOPS' Quality Plan and the Risk Plan, which describes:

- General quality control measures and actions, quality control of documentation, quality systems and quality control board such as deliverable peer review & control.
- The internal quality control of the whole project, including reporting and monitoring, and possible corrective and preventive actions.
- Identification of potential risks and related mitigation measures, as well as the necessary contingency plans towards eliminating them.

Furthermore, the document provides SYCLOPS partners with guidelines, rules and instructions stated for the management of technical documentation, cost statements, and deliverables, ensuring effective management and coordination so to run the project's function in a consistent and clear way.

2 Project Management Plan

2.1 Project Objectives

The vision of SYCLOPS project is to enable better solutions for AI/data mining for extremely large and diverse data by democratizing AI acceleration using open standards, and enabling a healthy, competitive, innovation-driven ecosystem for Europe and beyond. In order to achieve this vision, SYCLOPS will integrate expertise in computer architecture, programming languages, systems and runtimes, Big Data, High-Performance Computing, autonomous systems, High-Energy Physics, and precision oncology, with the aim of developing novel infrastructure, platform, and application tools for AI acceleration.

This vision relies on the convergence of two important trends in the industry: (i) the standardization and adoption of RISC-V, a free, open Instruction Set Architecture (ISA), for AI and analytics acceleration, and (ii) the emergence and growth of SYCL as a cross-vendor, cross-architecture, data parallel programming model for all types of accelerators, including RISC-V.

The goal of project SYCLOPS is to bring together these standards for the first time in order to (i) demonstrate ground-breaking advances in performance and scalability of extreme data analytics using a standards-based, fully-open, AI acceleration approach, and (ii) enable the development of inter-operable (open and vendor neutral interfaces/APIs), trustworthy (verifiable and standards-based hardware/software), and green (via application-specific processor customization) AI systems.

The main challenges will be faced by SYCLOPS are:

1. RISC-V, with its open, customizable ISA, is rapidly gaining popularity as the hardware platform of choice for AI accelerator design. However, with design automation tools used by RISC-V vendors today, implementation and verification of custom extensions is largely a manual process with limited automation. The net result of these limitations is that current Electronic Design Automation (EDA) tools do not support the advanced micro-architectural features required by RISC-V cores.

2. In order to fully exploit the underlying heterogeneity in hardware for achieving ground-breaking improvement in performance, a state-of-the-art (SOTA) software platform for extreme analytics should provide the following functionalities: (i) a standard programming model that allows data parallel computations to be expressed at a high level once in a single source file while guaranteeing portability across diverse architectures, (ii) a modular compiler toolchain that can support the unified frontend and a variety of processor backends, (iii) a dynamic, cross-device kernel runtime that can track data dependencies and provide application-aware scheduling of kernels on processors, (iv) an interactive programming infrastructure that facilities ad-hoc analytics at the extreme scale.

3. End-users in all application domains often rely on highly-optimized libraries (math libraries like cuBLAS/cuFFT, genomics kernels in Parabricks library, neural network primitives in cuDNN) that support most common computational tasks, and performance profiling tools (nvprof, Intel VTune) to fine tune their application. While a few such libraries and tools exist for SYCL, they are very limited in functionality and do not provide support for several features that are fundamental to achieving cross- architecture acceleration in SYCLOPS use cases.

4. The open standards that form the building block of SYCLOPS (RISC-V and SYCL) are orthogonal to each other, and have each gained traction in their respective communities. However, in order to convincingly demonstrate that a fully open hardware acceleration stack can compete with closed-source competitors, one needs to prove SYCLOPS' ability to achieve parity with SOTA in different use case scenarios that represent the fastest developing industry verticals for AI acceleration.

5. Despite substantial interest and activity with respect of both SYCL and RISC-V, tooling and developer support still lags well-established proprietary solutions, like CUDA, considerably as these standards are relatively new. While project SYCLOPS will certainly play a key role in furthering the

cause for standards-based hardware acceleration for extreme analytics, it is not the be-all and end-all. In order to foster an open ecosystem, we need feedback to the standards and support from an open community of organizations and individuals who are stakeholders, continued open-source development for building tools and libraries based on the standard, effective dissemination to encourage uptake of new such tools in various application verticals, and a user-driven feedback loop to enable continued evolution of standards to meet new requirements.

The main objectives of the SYCLOPS project that aim to overcome the aforementioned challenges are reported in the table below.

No.	Objective
1	To develop tools and technologies for enabling automated customization of RISC-V accelerators
2	To develop platform tools (compilers, interpreters and cross-device runtime) for enabling portable, parallel, cross-architecture programming on heterogeneous hardware
3	To develop application tools (profiling and porting tools, and hardware-acceleration libraries of parallel algorithms, mathematical operators, and machine learning primitives) for enabling cross-architecture application development.
4	Test, benchmark, and demonstrate the effectiveness of SYCLOPS in searching and processing extremely large amounts of diverse, heterogeneous data with three use cases in autonomous systems, genomic analysis, and high-energy physics.
5	To foster an open, innovative European ecosystem for accelerated AI and analytics by leading and feeding back to standardization efforts and communicating project outcomes via already well-established dissemination channels and developer communities

Table 1 - SYCLOPS Objectives

2.2 Legal Basis

SYCLOPS is a European RIA project funded by Horizon Europe - the EU Framework Programme for Research and Innovation, Grant Agreement no 101092877, officially entered into force on 1 January 2023. The Consortium Agreement has also been signed by all partners in December 2022.

2.3 Main Contacts

Technical, Scientific, and Overall Project Coordinator

- Raja Appuswamy
- EURECOM
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EU Project Officer

- LEPPANEN Riku
- E-mail: Riku.LEPPANEN@ec.europa.eu

2.4 Governance Structure

Major fields of activity for the management team of the SYCLOPS project are the coordination of work, the integration of researchers with a wide variety of expertise, and project administration. In SYCLOPS, Raja Appuswamy from EURECOM will act as both the Project Coordinator and the Scientific Coordinator. As the Project Coordinator, he is in charge of the following activities:

- overseeing action plans and monitoring their timely execution
- submission of Deliverables and Periodic Reports to the EC
- monitoring of partners' PM and costs
- project administration and reporting activities
- monitoring compliance of the parties with their obligations
- chairing the General Assembly and the Executive Board, and follows-up on their decisions
- managing the financial contribution of the European Commission
- maintaining details of approvals to material that is subject to Controlled License Terms

As the Scientific Coordinator, he is in charge of the following activities:

- ensuring all technical and scientific activities to be consistent and dependable having a balance between the scientific horizon and technology sustainability;
- monitoring the overall quality of deliverables;
- monitoring the process and leading technical decisions based on the technical assumptions;
- setting the baseline for technological assumptions.
- monitoring and keep track of all the scientific innovative assumptions and relevant scientific achievements, also from the perspective of protecting the generated knowledge.

The organizational structure of the consortium also comprise the Consortium Bodies described below.

The **General Assembly** is the ultimate decision-making body of the Consortium. It includes at least one representative of each Party and is chaired by the Coordinator. The Partners may appoint up to two or more different representatives to represent both the technical-scientific area and/or the administrative area. Each Partner has one vote, in case of equal votes the Coordinator has the decisive one.

The General Assembly will meet at least once per year to review and plan the project work; additional online meetings will be arranged if necessary. Any Partner may raise issues, that will be discussed inside the GA. In general, the GA decides:

- allocation/reallocation of the Action's budget
- reviews/amendments to the Grant Agreement terms
- changes to the Action Plan
- accession and withdrawal of a Party
- termination of a Defaulting Party
- change of the PC
- on proposals made by the Executive Board
- appointment, if necessary, of External Expert Advisory Board Members

The **Executive Board** as the supervisory body for the execution of the Project which shall report to and be accountable to the General Assembly. It is made up of the Project Coordinator and WPs' Leaders to guarantee the quality of the WPs and the project in general, supporting the management of the different scientific and technical aspects. The Executive Board will organize periodical meetings to ensure that the WPs activities, developments and general project progress are well coordinated. In particular, the Executive Board will:

- define the timetable of the project activities
- evaluate and validate the WPs' scientific and technical progress
- check procedures for publications and press releases about the project
- identify potential risks and suggest any corrective actions

The **Work Package (WP) Leaders** and **Task Leaders** are responsible for the overall management and coordination at WP level and for the achievement of the defined results. Work Package Leaders will manage their own WPs, in cooperation with the Task Leaders. WP Leaders will be responsible for the coordination of the work carried out, the achievement of the objectives and the production of deliverables and reports resulting from their own WPs.

No.	WP Title	Lead partner	Leader	Contributors
1	Project Management	EUR	Raja Appuswamy	**All partners**
2	Architecture	EUR	Raja Appuswamy	All partners
3	Infrastructure Layer	HIRO	Fred Buining	EUR, HIRO, CSIP
4	Platform Layer	UHEI	Vincent Hueveline	EUR, HU, CERN, CPLAY, CSIP
5	Application, Libraries & Tools Layer	CERN	Axel Naumann	**ECOM, INESC, CERN, CPLAY, ACC**
6	Exploitation, Dissemination, Standardization	CPLAY	Mehdi Goli	All partners

Table 2 - Overview of the SYCLOPS WP Leaders

Each WP is divided into several tasks; each task is coordinated by a Task Leader. Other partners act as contributors. Task Leaders have the following responsibilities:

- ensure the communication and collaboration with the respective WP Leader and the other Task Leaders of the WP
- ensure the activities of the task proceed according to the work plan
- ensure the planning, coordination, and supervision of tasks, as well as the quality of the results
- identify potential risks and corrective actions

Task	Task Title	Task Leader	Contributors
1.1	Administration and financial management	EUR	All Partners
1.2	Scientific and technical management	EUR	WP Leaders
1.3	Data, risk management and ethical aspects	CPLAY	WP Leaders
2.1	Interface specification and compatibility	EUR	HIRO, CSIP, CPLAY, HU, INESC
2.2	Benchmark specification and performance profiling	INESC	CPLAY, CERN, ACC, CSIP
2.3	Use cases & SYCLOPS validation	CERN	CPLAY, ACC
3.1	Processor description language & EDA	CSIP	-

3.2	RISC-V reference platform	CSIP	HIRO
3.3	EMDC assembly	HIRO	CSIP, EUR
4.1	Compiler support for RISC-V	CPLAY	HU, CSIP
4.2	SYCL graph runtime	HU	CPLAY, EUR
4.3	Interactive SYCL interpreter	CERN	CPLAY, HU
5.1	CUDA to SYCL porting tool	CPLAY	-
5.2	SYCL deep neural network acceleration library	CPLAY	EUR
5.2	SYCL ROOT acceleration library	CERN	CPLAY
5.3	SYCL genomics acceleration library	ACC	INESC, EUR
6.1	Dissemination	EUR	All Partners
6.2	Communication and networking	CPLAY	All Partners
6.3	Market, Innovation and Applicability Analysis	CSIP	CPLAY, ACC, EUR
6.4	IPR Management, Exploitation Strategy and Sustainability	CSIP	CPLAY, ACC, EUR
6.5	Standardization	CPLAY	All Partners

Table 3 - Overview of the SYCLOPS Task Leaders

External Advisory Board (EAB)

An External Advisory Board will support the SYCLOPS Project Management in ensuring the overall quality of the innovation and project's outputs, providing high level inputs and guidance. The Advisory Board is made up of three leading experts, one for each layer of the SYCLOPS stack, in the fields of:

- RISC-V, computer architecture, data center design (Infrastructure layer)
- Compilers, interpreters, SYCL (Platform layer)
- Cross-architecture acceleration, algorithms (Applications layer)

Gender balance and equitable geographical representation will be ensured in the composition of the members of the EAB. The consortium is currently identifying EAB members. Potential candidates will be presented to the Project Officer, in order to receive input from the European Commission before contacting them. The EAB will be invited to join the key project meetings throughout the duration of the project (e.g., the General Assemblies), contributing with their opinion, input, feedback and recommendations; if needed, a review of project deliverables will be requested. The EAB will be consulted also when coming across crucial project management decisions with respect to evaluation of particular project outputs.

The Table below provides the list of Deliverables identified by the Coordinator that will be reviewed by External Advisory board members.

Background area of the EAB Member	Deliverables name (Delivery month)	Lead partner
Infrastructure layer (RISC-V, computer architecture, data center design)	D3.1 EMDC v1.0 with RISC-V platform release (M18)	CSIP
	D3.2 EMDC v2.0 with RVV accelerator release (M33)	HIRO
Platform layer (Compilers, interpreters, SYCL)	D4.1 RISC-V compiler backends (M18)	UHEI
	D4.2 ACORAN compiler with autovectorization (M33)	CPLAY
	D4.3 hipSYCL graph runtime & cross-device scheduling (M33)	UHEI
	D4.4 SYCL interpreter (M33)	CERN
Application layer (Cross-architecture acceleration, algorithms)	D5.1 SYCL to CUDA porting tool (M33)	CPLAY
	D5.2 SYCL-DNN library (M33)	CPLAY
	D5.3 SYCL-ROOT library (M33)	CERN
	D5.3 SYCL-GAL library (M33)	ACC

Table 4 - Deliverables to be reviewed by EAB members

The deliverables identified align the EAB with the most relevant deliverables to their background as well as being deliverables which contribute significantly to the completed SYCLOPS platform.

2.5 Work Plan

The SYCLOPS project is planned to run for 36 months. To ensure that project objectives are fulfilled, SYCLOPS assigns participants to their respective tasks in a coherent manner. A clear project structure will lead participants along a logical line to reach the project objectives, and continuous communication will guarantee the involvement of all project partners at all stages of the project.

The figure below illustrates the relationships between the WPs and the flow of information and results (represented by arrows) among them.

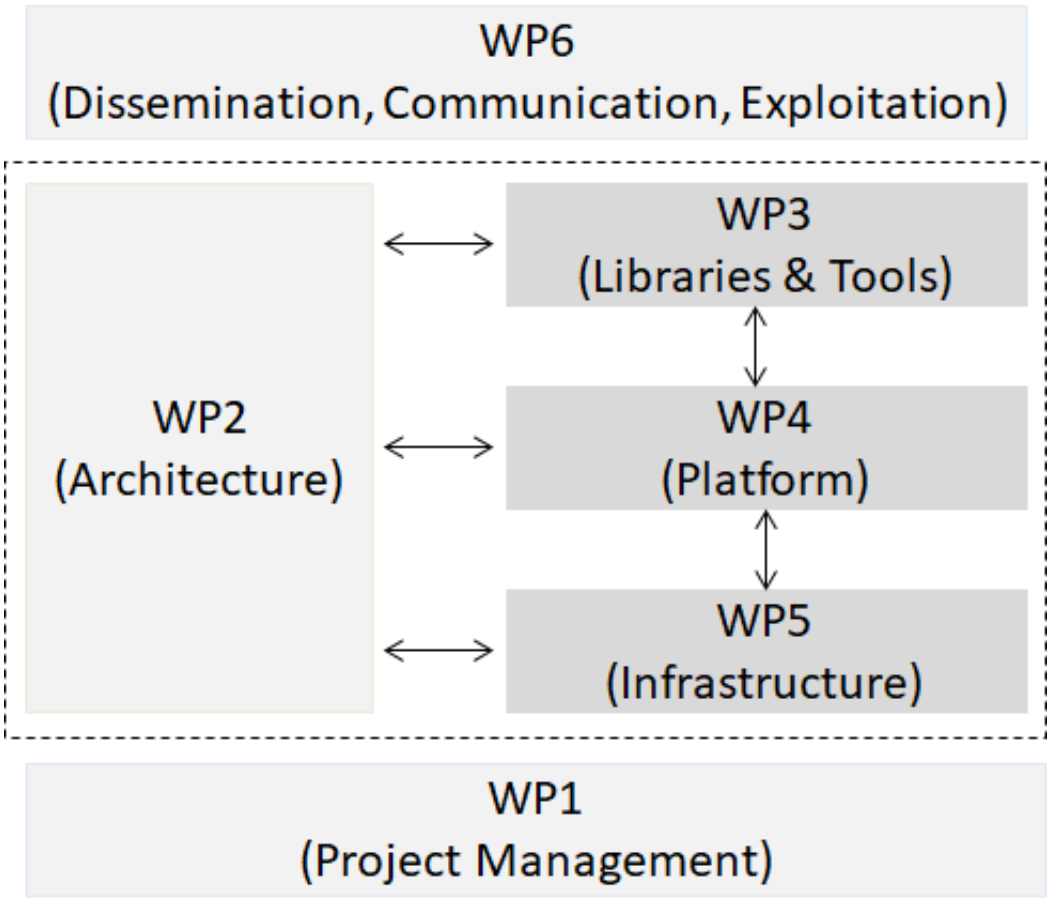

Figure 1 - SYCLOPS Work Packages Interrelation Diagram

The project is organized into six Work Packages of which four include scientific and technical activities (from WP2 to WP5), and the other two cover management (WP1), communication, and dissemination (WP6) activities. All WPs have clear objectives and mutual links, as described below.

Management Work Package

- WP1 (Project Management) will cover all aspects of project management, control, and quality to ensure that the project successfully achieves the planned objectives on time and within the budget.

SYCLOPS core Technical Work Packages

- WP2 is a transverse WP that contains tasks that span multiple layers of the SYCLOPS stack and has three objectives: (i) Identify the set of interfaces and APIs to ensure cross-layer compatibility, (ii) Specify test scenarios, profiling tools, and benchmarking methods for a reproducible evaluation, (iii) Validate the SYCLOPS stack at an early prototype stage and at a scaled-up, completed stage.

- WP3 focuses on the infrastructure layer, which is the bottom-most layer of the SYCLOPS stack, and contains tasks for developing the hardware testbed and development cloud environment that will be used by higher layers of the stack.
- WP4 focuses on the platform layer of the SYCLOPS stack and contains tasks for developing SYCL compilers, runtime, and interpreters that will be used for application development by higher layers of the stack
- WP5 focuses on the application libraries layer of the SYCLOPS stack and contains tasks for developing the key acceleration libraries that will be used for end-to-end validation by the use cases.

Communication Work Package

- Finally, WP6 will receive input from all technical and scientific WPs and will maximize the impact of the project through communication and dissemination of the project results, increase awareness of the scientific, industrial, and general public communities.

Detailed Project GANTT

The table below shows the detailed project GANTT chart. The shading at task level (orange) maps each task to the four phases of the project and their duration. Ths shading at the WP level (red) shows the duration of each WP.

		1	3	6	9	12	15	18	21	24	27	30	33
WP1	**Project management**												
1.1	Administration and financial management												
1.2	Scientific and technical management												
1.3	Data, risk and ethics management												
WP2	**Architecture**												
2.1	Interface specification and compatibility												
2.2	Benchmark spec. and perf. modelling												
2.3	Use cases & SYCLOPS stack validation												
WP3	**Infrastructure layer**												
3.1	Processor description language, EDA												
3.2	RISC-V reference platform development												
3.3	EMDC assembly												
WP4	**Platform layer**												
4.1	SYCL compiler backends												
4.2	SYCL graph runtime												
4.3	Interactive SYCL interpreter												
WP5	**Application libraries & tools layer**												
5.1	SYCL DNN acceleration library												
5.2	SYCL genomics acceleration library												
5.3	SYCL ROOT acceleration library												
WP6	**Exploitation & Dissemination**												
6.1	Dissemination												
6.2	Communication and networking												
6.3	Market and innovation analysis												
6.4	IPR, exploitation and sustainability												
6.5	Standardization												

Table 5 – GANTT chart

2.5.1 Reporting to the European Commission

Reports to the Commission will ensure the proper implementation of the project objectives both from the consortium side as well as the Commission. All reports are presented in the deliverables list which can be found in the GA page 5—6.

SYCLOPS is divided in two reporting periods of the following duration:

- First Reporting Period: from month 1 to month 18

- Second Reporting Period: from month 19 to the last month of the project (month 36). During the project, an interim and a final EU review meeting will be held, as indicated in the following table.

Review number	Tentative timing	Event	Mechanism
First review meeting	M20	Interim review	Official dedicated review meeting with reviewers. Technical review linked to payment following the end of the first reporting period.
Second review meeting	M36	Final review	Official dedicated review meeting with reviewers.

Table 6 - Project Review Events

During the First Reporting Period, 11 official deliverables will be provided (in order): D1.1, D6.1, D1.2, D2.1, D6.2, D6.3, D6.6, D1.3, D3.1, D4.1

During the Second Reporting Period the remaining deliverables will be provided: D6.4, D2.2, D3.2, D4.2, D4.3, D4.4, D5.1, D5.2, D5.3, D5.4, D2.3, D6.5, D6.7

Progress reports will be produced as internal documents at **M12**, **M24** and **M30**, based on the inputs received from the WP leaders, and shared with the PO, to keep her updated with the project's status.

Periodic Reports will be submitted after the end of the First Reporting Period (**M18**) and at the end of the project (**M36**). According to the Grant Agreement, the Periodic Reports must include a technical and a financial part, as detailed below:

- The "Periodic Technical Report" outlines the project implementation status. Specifically, it includes:
    - structured tables with main project information (e.g., list of deliverables, milestones, list of critical risks, including unforeseen risks and the state of play, dissemination and communication activities, etc.)
    - an explanation of the work carried out by the beneficiaries, project's progresses, and an overview of the progress towards the objectives of the action, including milestones and deliverables identified in the Grant Agreement.
    - The report shall also detail a summary for publications by the Commission, and explanations justifying the differences between the work expected to be carried out (in accordance with the GA) and the work performed, if any (e.g., budget overruns, delays, work not implemented, etc.)
- The "Periodic Financial Report" shall contain
    - financial statements (individual and consolidated) for all beneficiaries and affiliated entities, for the reporting period concerned
    - justification on the use of resources and cost explanations
    - certificates on the financial statements (CFS), under the conditions specified in Article 21.2 of the Grant Agreement

The financial statements shall detail the eligible costs for each budget category; all eligible costs should be declared, amounts that are not declared in the financial statements will not be taken into account by the Commission.

2.5.2 Interim Reporting

The reporting scheme inside the consortium will have three main objectives: (1) to facilitate internal reporting within the project, (2) to allow the Coordinator to collect the information needed for the onward reporting of progress and flagging of problems to the EC, and (3) to provide information on the quality assurance including confirmation that quality control procedures are in force.

Each Partner will be responsible for the elaboration and timely distribution of the reports assigned to it. The following types of reports have been identified for its use throughout the duration of the Project:

- Progress Reports
- Technical Reports
- Cost Statements and Financial Reports
- Presentations

Likewise, the Project Coordinator may request ad-hoc reports at any time, which shall be submitted within the next month period, unless specified otherwise. In order to demand reports, the Coordinator should send a mail specifying the objective of the report, the information and structure needed, the responsible partner(s) to produce it, and the expected deadline.

2.6 Deadlines

All deliverables shall be reviewed before the official EC deadline to facilitate the correct and efficient check according to the peer review process. Key principle is that deliverables should be finalized, and already reviewed internally at WP level, 20 working days before submission deadline. Secondly, the deliverable responsible partners shall send the deliverables to the Coordinator, who will be in charge of coordinating the review process. The review process is fully described in Chapter 5.3. The table below illustrates the official EC deadlines for Deliverables' submission.

Work Package No	Deliverable Related No	Deliverable Name	Lead Beneficiary	Due Date
WP1	D1.1	Project management, quality, and risk plan	EUR	31-Mar-23
WP6	D6.1	Communication, Networking and Dissemination Plan and Activities	CPLAY	31-Mar-23
WP1	D1.2	Data Management Plan	CPLAY	30-Jun-23
WP2	D2.1	Architecture, interface, and benchmark specification	HIRO	30-Jun-23
WP6	D6.2	SYCLOPS IPR Management, Business Models, and Business Plan	CSIP	31-Dec-23
WP6	D6.3	Communication, Networking and Dissemination Plan and Activities M12	CPLAY	31-Dec-23
WP6	D6.6	SYCLOPS IPR Management, Business Models, and Business Plan M24	CSIP	31-Dec-23
WP1	D1.3	Data Management Plan M15	CPLAY	31-Mar-24
WP3	D3.1	EMDC v1.0 with RISC-V platform release	HIRO	30-Jun-24
WP4	D4.1	RISC-V compiler backends	UHEI	30-Jun-24
WP6	D6.4	Communication, Networking and Dissemination Plan and Activities M24	CPLAY	31-Dec-24
WP2	D2.2	Cross-architecture performance modeling and profiling tools	INESC	30-Sep-25
WP3	D3.2	EMDC v2.0 with RVV accelerator release	CSIP	30-Sep-25
WP4	D4.2	ACORAN compiler with auto-vectorization	CPLAY	30-Sep-25
WP4	D4.3	hipSYCL graph runtime & cross-device scheduling	UHEI	30-Sep-25
WP4	D4.4	SYCL interpreter	CERN	30-Sep-25
WP5	D5.1	CUDA to SYCL porting tool	CPLAY	30-Sep-25

WP5	D5.2	SYCL-DNN library	CPLAY	30-Sep-25
WP5	D5.3	SYCL-ROOT library	CERN	30-Sep-25
WP5	D5.4	SYCL-GAL library	ACCELOM	30-Sep-25
WP2	D2.3	Use case integration, validation and demonstration report	CERN	31-Dec-25
WP6	D6.5	Communication, Networking and Dissemination Plan and Activities M36	CPLAY	31-Dec-25
WP6	D6.7	SYCLOPS IPR Management, Business Models, and Business Plan M36	CSIP	31-Dec-25

Table 7 - Project Deliverables' Deadlines

2.7 Project Management Tools

Project Repository: A shared folder has been created and hosted by the Coordinator's institution which will act as a file archive facility. Access to the repository will be controlled via a username (e-mail address) and granted only by the host of the repository (the Project Coordinator). Important project files will be stored and maintained on the repository, e.g., the current version of the DoA, templates, minutes of important meetings.

The repository will include a folder structure and most project related files will fit within this; in particular, there will be a folder related to each Work Package and others will be created on demand. Partners are recommended to not delete any of the existing folders. However, partners are encouraged to add further sub-folders where relevant, e.g., for each additional meeting or for WP information. Sub-folders may also be created for storing strictly private temporary files where, for example, these are too large to circulate by e-mail.

This tool assists project partners to interact with the project team at all stages of the project, but also gain an overview of final documentation produced and distributed, schedule of activities, past events, etc.

Collaborative Coding Tool: given the nature of some activities to be carried out within SYCLOPS, Git will be used as collaborative coding tool with GitHub or Gitlab being used to host the repositories which will be created as part of the project.

2.8 Description of a Common Working Process

To guarantee a smooth working process, the SYCLOPS consortium plans to convene in person at least once a year to monitor progress and exchange information. In this regard, the Project Coordinator will oversee the organization of the meetings.

In parallel, periodic calls will be organized by the Project Coordinator:

- **Plenary meetings** involving all the SYCLOPS consortium members, to ensure the full control of the activities' implementation, share progresses and have a global view on project's activities
- **WP Leaders calls** involving all the SYCLOPS WP Leaders, to provide an overview of the WP advancements and progresses, especially in relation with the project timeline. During these calls, consortium partners who are not WP Leaders may be invited to join whenever relevant for the meeting.

2.9 Change Management Procedures

Change management procedures have been established to (1) manage withdrawal of a partner, including processes to complete outgoing partner's tasks as well as to (2) manage the process to incorporate possible new partners.

Below the Consortium Bodies/partners involved and their main responsibilities are reported.

- **General Assembly:**

- manages the procedure when a partner leaves the Consortium. Any partner can leave the project by notifying the General Assembly of their intentions. The withdrawal of a partner will comply with the conditions and consequences described in the project Grant Agreement.
- defines the candidate to become partner among those proposed by consortium parties.

- **Project Coordinator:**
  - informs the General Assembly and the Executive Board that a partner wishes to leave the Consortium.
- **General Assembly, Executive Board:**
  - In case of withdrawal of a partner, the General Assembly and the Executive Board contribute to the identification of another suitable candidate (with the contribution of all parties) to become a partner and contribute to the development of the outgoing partner's tasks.
- **All partners**
  - During the search of a new substitute party, the partners of the Consortium able to deal with the same tasks previously assigned to the leaving partner, will be involved in such tasks to minimize the negative impact on the work planned.
  - Propose new candidates to become partners of the project.

2.10 Legal and Financial Management

The main objective of the legal and financial management is to implement the overall legal, contractual, and financial management of the Consortium.

Responsibilities of the Project Coordinator:

- To facilitate the drafting, adjustment, signing and management of the Consortium Agreement to be agreed between the parties
- To distribute the share of budget to all Parties according to the schedule defined in the Consortium Agreement, after receiving payments directly from the EU Commission
- To monitor the overall use of resources and costs throughout the project implementation and keep accounts of the funds' distribution to partners (including the date of transfer)
- To manage Financial and legal reporting to the EU Commission.

Responsibilities of all partners:

- Periodical submission (every 12 months) to the Project Coordinator of their effort consumption. At the end of each Reporting Periodic, submission of their financial statements
- Communication and convocation of meetings throughout the project implementation, when necessary.

2.11 Information Management

Within the SYCLOPS project, the information management system aims at: (1) ensuring smooth and timely flow of information among all consortium participants on decision-making matters; (2) ensuring timely presentation of reports and relevant information to the EU Commission; (3) facilitating integration of research in the various areas covered by the project and helping intra-consortium sharing of techniques and results.

The Project Coordinator, WP Leaders and all meeting organizers in general are primarily involved in the information management process. In particular,

- The Project Coordinator will:
    - Organize project meetings, General Assemblies and Review Meetings
    - Maintain contacts' database and ensure access by all participants.
- All meeting organisers will:
    - Organize meetings (including the online ones), draft and distribute the agenda, as well as specific guidelines when necessary
    - Take the minutes of the meetings and share the agreed action points
    - Monitor progress and achievements of the action points after the meeting, as well as inform all participants of the actions' outcomes.

2.12 Meetings

Within the framework of the SYCLOPS project, both physical meetings and teleconference calls will be organized; these meetings are subject to basic regulations, which are explained in the following subsections.

A meeting calendar will be updated by the Project Coordinator. This will help to keep an overview of the scheduled meetings and to plan meetings with foresight. The online kick off meeting has already been completed. We tentatively envision **3 General Assembly** meetings and **2 Review Meetings** during the course of the SYCLOPS project as shown below

Meeting	Attendees	When
Kick-Off meeting	Consortium Members and EU Commission	M1 (completed)
Y1 General Assembly	Consortium Members	M9
Y2 General Assembly	Consortium Members	M18
Review Meeting	Consortium Members and EU Commission	M20
Y3 General Assembly	Consortium Members	M30
Review Meeting	Consortium Members and EU Commission	M36

Table 8 - Project Meetings

The SYCLOPS consortium plans to convene once a year, ideally in conjunction with a relevant activity. Three General Assembly meetings will take place during the lifetime of the project in order to:

- monitor progress
- decide on the course of action
- encourage partners' interactions
- exchange important pieces of technical and strategic information.

At all General Assemblies, the progress of the project - as reported by the WP Leaders and Task Leaders - and the outlook for exploitation of the results will be critically reviewed and compared to the planning described in the Grant Agreement. Consequently, a change in the work plan may be proposed to ensure the success of the project. The General Assemblies, will be held in-person if there are no force majeure restrictions. If needed, the remote connection will be ensured to facilitate the participation of consortium partners unable to travel.

2.12.1 Representation in Meetings

All consortium partners

- should be present or represented at any General Assembly meetings;
- may appoint a substitute or a proxy to attend and vote at any General Assembly
- and shall participate in a cooperative manner in the meetings.

The Project Coordinator shall prepare and send each Member of the following Consortium Bodies a written agenda no later than ten days preceding the meeting.

2.13 Voting Rules and Quorum

Each Consortium Body shall not deliberate and decide validly in meetings unless two-thirds (2/3) of its Members are present or represented (quorum).

If the quorum is not reached, the chairperson of the Consortium Body shall convene another ordinary meeting within 15 calendar days. If in this meeting the quorum is not reached once more, the chairperson shall convene an extraordinary meeting which shall be entitled to decide even if less than the quorum of Members is present or represented.

Each Member of a Consortium Body present or represented in the meeting shall have one vote.

Please note:

- A Party which the General Assembly has declared to be a Defaulting Party may not vote.
- Parties where there is an issue of Default/Termination/Resignation being discussed in respect of them may not vote on that item. As soon as a Party is no longer considered to be a Defaulting Party, its vote rights are re-instated.
- Decisions shall be taken by a majority of two-thirds (2/3) of the votes cast.

Any decision may also be taken without a meeting if the Coordinator circulates to all Members of the Consortium Body a written document, including the deadline for responses, which is then agreed by the defined majority of all members of the Consortium Body, and if no Member has sent an objection in writing to the Coordinator. A veto according to Section 2.13.1 may be submitted up to 15 calendar days after receipt of this information, in writing to the Coordinator.

2.13.1 Veto Rights

A Party which can show that its own work, time for performance, costs, liabilities, intellectual property rights or other legitimate interests would be severely affected by a decision of a Consortium Body may exercise a veto with respect to the corresponding decision or relevant part of the decision, provided that the Party concerned provides written proof that its legitimate interests are seriously affected by a decision of the Consortium Body. Such veto shall be reasonably and duly justified.

When the decision is foreseen on the original agenda, a Party may only veto such a decision during the meeting.

When a decision has been taken on a new item added to the agenda before or during the meeting, a Party may veto such decision during the meeting or within 15 calendar days after receipt of the draft minutes of the meeting. A Party that is not appointed to participate to a particular Consortium Body may veto a decision within the same number of calendar days after receipt of the draft minutes of the meeting.

When a decision has been taken without a meeting a Party may veto such decision within 15 calendar days after written notice by the chairperson of the outcome of the vote.

Please note:

- In case of exercise of veto, the Members of the related Consortium Body shall make every effort to resolve the matter which occasioned the veto to the general satisfaction of all the Parties.

- A Party may neither veto decisions relating to its identification to be in breach of its obligations nor to its identification as a Defaulting Party. The Defaulting Party may not
- veto decisions relating to its participation and termination in the consortium or the consequences of them.
- A Party requesting to leave the consortium may not veto decisions relating thereto.

2.13.2 Meeting Minutes

The chairperson of a meeting shall produce written minutes of the meeting which shall be the formal record of all decisions taken. He/she shall send the draft minutes to all Members within 15 calendar days of the meeting.

The minutes shall be considered as accepted if, within 15 calendar days from sending, no Member has sent an objection to the chairperson with respect to the accuracy of the draft of the minutes by written notice.

The chairperson shall send the accepted final minutes to all the Parties and to the Coordinator, who shall retain copies of them.

2.14 Communication

2.14.1 Contact with the European Commission

The Project Coordinator is the sole responsible for the communication with the Project Officer of the European Commission about any matter related to the project. Only in exceptional cases, and if the PO requires so, a project partner may contact the PO directly. In this case, the PC is kept fully informed (in written form) about the communication process. Communications with the European Commission will be in spoken or written English.

The PC also provides any additional information and / or clarification (that have been requested by the PO) to the EC and keeps the consortium informed about any important communication with the EC. Finally, the PC has the responsibility of submitting all SCYLOPS reports and deliverables to the EC.

2.14.2 Emails and Distribution Lists

To facilitate information exchange within partners, a dedicated mailing list has been created since the beginning of the project with all consortium members. Further lists can be created per WP if deemed necessary. The SYCLOPS contact list will be kept updated and available in the SYCLOPS private area.

2.14.3 Conference Calls

Conference calls will be held by using the Zoom, Teams, or WebEx. The partner in charge of the meeting organisation will send via email all the instructions to connect to the meeting in advance.

2.14.4 Dissemination

A project website has been set up and regularly updated: http://www.syclops.org/. The website is part of the project dissemination strategy and will constitute one of the main means through which the public will be able to follow project evolution. More information will be provided in Deliverable D8.1 “Communication, Networking and Dissemination Plan and Activities – initial” due at M3.

2.15 Work Allocation

A table summarizing the planned resources in terms of Person-Months for each partner and work package is provided below. This table will help the consortium to keep track of any deviations (actual vs. planned resources) at the time of the submission of the periodic report or final report.

	WP1	WP2	WP3	WP4	WP5	WP6	Total Person-Months per Participant
1. EUR	40	10	15	15	15	8	**103**
2. INESC	1	35	0	0	31	3	**70**
3. HU	1	10	0	46	0	5	**62**
4. CERN	1	20	0	20	14	3	**58**
5. HIRO	1	5	31	0	0	3	**40**
6. CPLAY	10	15	0	40	40	30	**135**
7. ACC	1	15	0	0	15	5	**36**
8. CSIP	1	10	48	5	0	10	**74**
Total Person Months	**56**	**120**	**94**	**126**	**116**	**65**	**576**

Table 9 - Total Effort Distribution

A detailed list of the WPs effort allocation, as well as of the activities to be carried out within each WP, is available in the Grant Agreement document page 5—12.

3 Quality Plan

The Quality Plan (QP) defines the actions and procedures that will be taken by the Consortium order to ensure the high-quality level of the project outcomes and its full conformance with its contractual requirements. The main goals of the QP are to:

- provide to all concerned Consortium members a guide for the actions required by each one involved
- exhibit the performance of the project's quality plan in accordance with the contractual requirements
- decide which internal members of the Quality Control Board (see below) will review which deliverables.

The QP is applicable to all project's activities, to prevent deviations during each task of the project, and strict compliance with it is mandatory for all involved partners. The Project Coordinator shall ensure that the quality plan is followed and that its requirements are met throughout the duration of the contract and when contractual changes occur.

This section specifies the activities to be implemented, including their sequence, in order to ensure that the project and its deliverables conform to its requirements.

3.1 SYCLOPS Quality Planning and Control

Quality planning and control is an integral and essential part of the success of a project. Based on the QP, the Quality Control Board (QCB) will ensure that the quality control system is appropriate, that the QP is available to all concerned and that its requirements are met, as well as that effective quality planning has taken place.

The Quality system is reviewed within General Assembly meetings. In such reviews, the following items will be examined:

- results of project audits,
- results of internal audits,
- corrective action requests from the above,
- preventive actions for all the above,
- any project prototype deficiencies and subsystems/parts problems,
- level of used resources per category and adequacy of spent resources for task.

The outcomes from the above shall be discussed at General Assembly meetings, and their results shall be summarized and include:

- Satisfaction with the audits, corrective actions, and the results of complaints
- Dissatisfaction and requirements for further auditing or more corrective actions
- Satisfaction with the corrective actions taken by the relevant partner(s).

The minutes of the meeting - which include the partners attending and the summary of the points raised/resolved - will be produced, shared, and archived by the Project Coordinator.

3.2 Quality Control Board

This board is responsible for co-ordination and supervision of the implementation of the measures for quality assurance as well as for checking and evaluating the quality of the project activities and deliverables, which are expected to have a significant influence on the successful outcome of the project. Aspects to be addressed by the QCB include:

- Requirements of the project

- Organisational structure of the project
- Co-ordination between the members as well as the structured management levels of the consortium
- General measures and actions taken
- Planning and control

The QCB will be composed of the Project Coordinator and one representative from each partner whose contact details are provided in Annex A.

3.3 Deliverables Review, Peer Review and Control

The structure of peer-reviewing is meant to ensure timely submission of high-quality deliverables. Peer reviewers are the most appropriate for each deliverable and are selected among the Task leaders and contributors of the WP in which the deliverable is included. Each deliverable is evaluated according to the following schedule:

Deadline (working days)	Action
20 days before the deadline	**Deliverable responsible partner** finalizes the deliverable and send it to the assigned **peer reviewers** and **Technical and Scientific Coordinator** for peer review.
13 days before the deadline	**Peer reviewers** and the **Technical and Scientific Coordinator** review/comment the Deliverable and send it to **Deliverable responsible partner,** and for information to WP Leaders.
8 days before the deadline	The **Deliverable responsible partner** addresses revisions/comments and sends the revised version to the **Technical and Scientific Coordinator**, along with the description on how comments were addressed.
5 days before the deadline	The **Technical and Scientific Coordinator** on behalf of QCB members sends a final decision to the **Deliverable responsible partner** and for information also to WP Leader.
2 days before the deadline	The **Deliverable responsible partner** sends the Deliverable to the **Project Coordinator** for submission into the Funding and Tender Portal

Table 10 - Deliverables quality review

Only significant changes will lead to a repetition of the revision of submitted Deliverable (in case of an EU Commission's request).

3.4 Quality Control of Documentation

This section provides information about the document types of the project, the naming and coding of the project's deliverables, as well as the scheduling and reporting of the project's dissemination events.

3.4.1 Document Types

The types and structure of documents produced within SYCLOPS are described in the following table:

Deadline (working days)	Action
Deliverable	Describes the work done within a WP and/or task.
Technical Report	An internal report documenting technical work, a scientific paper submitted for publication, or is in press, or has already published, and which is uploaded in the SYCLOPS Git.
Meeting Calendar	Used to communicate the schedule of a project's event or meeting. In many cases, it can be just an e-mail to the project mailing list.
Meeting Agenda	Used to communicate the purpose and items to be discussed in a physical or virtual meeting. In many cases, it can be just an e-mail to the project mailing list.
Meeting Minutes	Summarizes the topics dealt during the meeting as well as the actions agreed.
Conference Call	Summarizes the topics dealt during a conference call as well as the actions

Minutes	agreed. In many cases, it can be just an e-mail to the project mailing list.
Presentation	Used to expound topics related to the project, both internally (Consortium meetings, a partner's vision/contribution, etc.) and externally (conferences, dissemination events, meetings, annual review meetings, etc.).
Financial Report	Filled in by the partners to state their costs.
Progress Report	Filled in by the partners to report on managerial issues, cost statements and justifications, as well as on planned and actual manpower spent within a certain reporting period.

Table 11 - Document types

3.4.2 Document Naming and Coding

For facilitating common browsing and storage in different platforms, no spaces should be used in the document names, and instead the dash character "_" should be used.

Project document names must start with the prefix "[SYCLOPS]" in order to facilitate quick identification and indexing. In particular, the following conventions are mandatory for certain types of documents. Names of deliverable documents should follow the convention:

"[SYCLOPS]_D.n_Deliverable_Name.YYMMDD.ext"

Where:

- Deliverable Name = name of the deliverable as indicated in the Part A of the GA
- "D.n" = the deliverable number
- "YYMMDD" = date of the document
- "ext" = file extension pertaining to the format used.

3.4.3 Dissemination

Dissemination activities include:

- Publications in scientific and technical journals or magazines;
- Publications in the printed or electronic press and media as well as on commercial journals or magazines;
- Presentations in conferences and publications in conference proceedings;
- Exhibition stands and demos;
- Participation in external workshops, forums and/or events.

The QCB should be informed as early as possible about the participation of any Partner member in any dissemination activity by email. The QCB is responsible for approving or not the participation in the specific dissemination activity. Particularly for scientific publications, the following procedure applies:

- An email concerning the planned publication along with its abstract (or a draft) is sent to the QCB (by an email to the Technical Director) at least 20-calendar days before the submission deadline. The coordinator informs the consortium about the planned publication. Both the abstract and the draft article will be shared to the partners when they are ready.
- The final version of the publication is uploaded on the project's document repository and resides there for inspection by the rest of the partners. If within 15-calendar days, no objection is raised by any partner to the QCB, the publication is allowed.
- A special provision is made in case of a submission to a conference publication: since there may be not enough time between the preparation of the final version and the required 15 days for final approval by the rest of the consortium, Step 2 is followed for the submitted to the conference version of the publication, provided that the submitted version is uploaded as a Technical Report on the online internal members area at most 1 day after the conference submission deadline.

- The QCP is responsible for resolving any objection raised by any partner.
- In any dissemination activity, the following quote should be included:

"This work has received funding from the European Union's Horizon Europe Research and innovation programme under grant agreement No. 101092877 (SYCLOPS) ."

The following rules will be applied and checked by the QCP to:

- Avoid repetition of publication of the same work, focusing on scientific project publications;
- Avoid publication of restricted and/or commercially confidential data;
- Avoid misunderstandings between Partners and publication of one's work without proper attribution;

3.5 Internal Quality Audit

The progress of the project will be monitored by the Coordinator through contacts (mainly by email and/or by teleconferencing facilities) with all the partners involved. All day-to-day and trivial barriers of the project must be dealt with in this way.

In exceptional cases, when a problem of paramount importance comes up with a certain partner, an Exceptional Internal Audit Procedure will be carried out by a specific project group. This group consists of:

- Project Coordinator
- Leader of the WP or Task within the problem occurred
- A member of QCB (not belonging to the certain partner site)
- Optionally, one or two other consortium members, which will be the most relevant (technical-wise) for the problem under inspection. Their participation will be decided by the QCB or by the coordinator and will depend on the nature of the problem.

In a first attempt, the Exceptional Internal Audit Procedure will be carried out remotely through a suitable teleconferencing facility. If the problem cannot be solved this way, then the aforementioned project group has to travel to the corresponding site in which the problem appeared.

All the findings of the Exceptional Internal Audit will be documented in an Internal Audit Report by the QCB member. Then, they will issue corrective actions, which again will be documented in the dedicated form, in order to solve all discrepancies, within the appropriate time period. Follow up actions will be arranged, so to ensure the effectiveness of the corrective actions. The results of the Internal Quality Audits will be distributed to all Partners, related to the specific WP.

3.6 Corrective and Preventive Actions

The issues listed below are related to general performance of partners and the quality of their work outputs (not to Project Deliverables). Any participant may raise such an issue on the work of another participant or external suppliers' work.

The Project Coordinator is responsible for solving matters of complaint under this procedure, within its own areas of responsibility. All complaints will be investigated, and corrective actions agreed. Possible corrective actions are recorded, and all involved actors are informed concerning the corrective measures to be defined. The formal description of the procedure is given below.

- The Coordinator identifies needs for corrective actions (e.g., by proposals from partners) and notifies the WP Leader
- WP Leader discusses the issue with the Task Leaders and comes up with the proposed solution. The relevant request is documented. There, also a proposal on the corrective action is made
- The solution is forwarded to the Coordinator via the WP Leader who decides on how to solve the issue at hand

The Coordinator communicates the corrective measures to be taken to all involved parties and monitors the related effective implementation.

3.7 Emergency Cases

Unpredictable factors (bankruptcy or non-completion of the assigned work and tasks) could raise emergency cases during the project, such as serious delays of deliverables. In these cases, a reallocation of resources can be considered. If the Coordinator envisages that these problems could put in risk the project's objectives or would have a significant negative impact on its overall activities, they will call for an extraordinary General Assembly meeting. After the deep analysis of the situation in the meeting, a decision will be made by the General Assembly. An appropriate revision of the work plan will be decided and communicated to the Commission for acceptance.

3.8 IPR Management

During the development of the SYCLOPS system and related technologies (in WP3, WP4, WP5), a number of software components will be produced. It is also expected that partners will generate Intellectual Property that eventually will have to be protected through licenses and exploited outside of the project. Tasks 6.3, 6.4, and 6.5 will carry out IPR reporting and the resolution of any issues related to IPR management. Secondly, they will produce an exploitation plan and strategy with the creation of a Quantified Business Plan, starting from an analysis of market potential, trends, players and business scenarios and providing indications about forecasts, ROI, risks, etc. tied to the individual partners' exploitation strategies. Based on these inputs, several potential exploitation scenarios for the SYCLOPS solution will be proposed, to ensure that the platform remains viable and sustainable after the project has run its course.

The Consortium Agreement that has been signed by the partners also deals with the management of the project generated knowledge and of the IPRs covering topics such as: joint ownership of the results, use and dissemination of knowledge arising from the project, transfer of results, access rights, etc. The Consortium Agreement also specifies in detail the rules and obligations regarding existing know-how and know-how developed during the project.

4 Risk Management Plan

4.1 Introduction

Risk Assessment is a core element in the research domain, and especially in projects that explore integrated intelligent solutions. Various opportunities and risks exist in every project providing a complex and often inter-related mix that research has to address. After being identified, possible risks must be mitigated. A contingency plan, therefore, is necessary to lower the possibilities of a delay or failure.

Risk is defined as an event that has a probability of occurring and could have a negative impact on the project. A risk may have one or more causes and, if it occurs, one or more effects. In the same context, a contingency plan is defined as a course of action to be followed if an emergency occurs.

This section presents the proposed contingency plans and actions to deal with the potential risks identified for the implementation phase of SYCLOPS. An overview of the method chosen to identify and estimate the severity of the risks is presented, based on EFMEA model. Following, a list of risks is exhibited, resulting after a thorough investigation and contribution from all partners. At this point, it has been made clear to the SYCLOPS Consortium that, the better the Risk Assessment, the better the Risk Management and consequently the better the expected project outcome.

To conclude, it is necessary to underline the fact that Risk Assessment is an ongoing process throughout the project's lifecycle. As such, it will be in progress until the end of the project.

4.2 Risk Management Plan

A five stage Risk Management Plan has been adopted for the needs of SYCLOPS including: Risk Identification, Risk Quantification, Risk Response Development, Risk Monitoring and Control, and Risk Documentation:

- Risk Identification examines the risks that can affect the project documenting the specific risk characteristics.
- Risk Quantification involves the evaluation of risks by determining the interactions, relationships, and implications to the project, identifying probabilities of occurrence, and assessing its possible effects.
- Risk Response Development involves the management of risks by determining response strategies plan, project reserves, and mitigation strategies.
- Risk Monitoring and Control involves controlling risks, making decisions on how to handle each situation, and take corrective actions.
- Risk Documentation contains the project database collecting historical information on the risks encountered.

For the first three stages a formal Risk Analysis and Assessment method is needed. Currently, over 100 Risk Analysis techniques are available in literature. The most common traits of them are the identification of initiating events (causes), consequences, safeguards, and recommendations. However, they differ in the way they identify causes or consequences. The five most popular techniques are "Hazard and Operability studies" (HAZOP), "Failure Modes and Effects Analysis" (FMEA) or "Failure Mode, Effects and Critically Analysis" (FMECA), "Expanded Failure Modes and Effects Analysis" (EFMEA), "What if" and "Risk c" (RADM)[1]. Considering the inputs and outputs of each method, the advantages and disadvantages, as well as the evaluation in the literature among Risk Analysis Methods in research environments[2], the EFMEA (Expanded Failure Modes and Effects Analysis) has been selected as the best and most suitable approach to meet SYCLOPS needs.

[1] The use of current risk analysis tools evaluated towards preventing external domino accidents. G.L.L. Reniers, W.Dullaert, B.J.M. Ale, K.Soudan. 3, s.l. : Elsevier, 2005, Vol. 18.

[2] Risk Analysis in research environments. A.Groso, A.Ouedraogo, T.Meyer., London : Routledge, 2012, Journal of Risk Research, Vol. 15, pp. 187-208

This method provides information to identify critical elements of the overall system, evaluate suitable actions and mitigation strategies, with the overarching goal of contributing to the contingency plans of the project. In EFMEA risk analysis is conducted in two stages: Risk Identification and Risk Mitigation. Also, EFMEA classifies Risks into four categories:

- Technical (physical features of hardware; coding elements of software)
- Legal (based upon existing policies and laws)
- Behavioural (resulting from user's behaviour)
- Organisational (in relation to disaster mitigation plans and actor's roles).

EFMEA is a rigorous method, relatively inexpensive, which accepts a high degree of complexity and is commonly used in a variety of industries for Risk Management, where simple quantification of risk is insufficient, and where identification of root causes of risks and means of mitigation are paramount.

In EFMEA, results can be correlated directly with actual risks and the effect of various methods of mitigation/detection on risk can be easily modelled. Moreover, it provides a well-documented record of improvements from the corrective actions implemented as well as useful information in developing test programs and in-line monitoring criteria. It also provides historical information, which is useful in analysing potential failures during the project lifecycle.

EFMEA is based on FMEA (Failure Modes and Effects Analysis)[3] improving some of its limitations.

4.3 Risk Registry

Risk registry contains a list with all the risks, which have been identified from the beginning of the SYCLOPS project, their grading in terms of area of expertise, the level of risk, their impact on WPs and the respective mitigating plans. SYCLOPS risk registry:

- provides a useful tool for managing and reducing the risks identified before and after the beginning of the project
- documents risk reduction and management strategies being pursued in response to the identified risks and their grading
- provides the trustees, management committee, and funders with a documented framework from which each risk status can be reported
- ensures the communication of risk management issues to key stakeholders
- provides a mechanism for seeking and acting on feedback to encourage the involvement of key shareholders

All partners have been involved in the identification of potential risks and definition of mitigation strategies and, a list with all risks, the level of risks, and the mitigation strategies was established.

All partners will continue to contribute towards identifying and fully describing the risks that may arise throughout the project's duration and within each WP and Task. These risks, if any, will be added to the SYCLOPS risk registry.

4.4 Expanded Failure Modes and Effects Analysis (EFMEA)

This section presents the methodology of the Expanded Failure Modes and Effects Analysis method. Initially, we provide a brief description of the classic FMEA.

FMEA is an analysis technique that facilitates the identification of potential problems in the design or process of a system by examining the effects of lower-level failures. Recommended actions or compensation provisions are made to reduce the likelihood of the problem occurring, and mitigate the risk, if in fact, it does occur. The FMEA determines, by failure mode analysis, the effect of each failure and identifies single failure points that are critical. It may also rank failure according to the criticality of a failure effect and its probability of occurring. This course of action, if succeeded, helps to identify potential failure

[3] Failure Modes and Effects Analysis Guide, Manufacturing Technology Committee – Risk Management Working Group, Product Quality Research Institute

modes based on past experience with similar products or processes, enabling those failures to be designed out of the system with the minimum of effort and resource expenditure, thereby reducing development time and costs. Some definitions are given below:

- Failure Modes are the ways, or modes, in which something might fail. Failures are any errors or defects, especially ones that affect the user, and can be potential or actual.
- Effect Analysis refers to studying the consequences of those failures and can potential mitigation strategies.

According to the seriousness of the consequences, the frequency of occurrence and their detectability, failures are prioritized. The combination of these three factors gives the Risk Priority Number (RPN) for each failure mode identified in the system. The purpose of the FMEA is to take actions to eliminate or reduce failures, starting with the highest-priority ones.

FMEA is a popular and broadly accepted methodology for Risk Analysis, which has been adopted by various projects. However, it has been criticized for having a number of limitations throughout the various calculation steps, such as tediousness, missing key failures and inability to affect key process decisions if performed too late.

As it has already been mentioned, within the scope of SYCLOPS, Expanded FMEA (EFMEA) designed to overcome some of the FMEA limitations, is being used. In the next sections, a brief description of the methodology is presented.

4.4.1 Calculation of Risk Priority Numbers

The results of SYCLOPS Risk Analysis must be comparable and thus must be presented in an understandable and comprehensive format – Risk Priority Numbers (RPNs). Such an analysis involves various factors of each safety-security issue: severity, occurrence probability, detectability, and recoverability, not only for technical risks, but also for behavioural, legal, and organisational risks.

Behavioural risks are related to the users' behaviour, regarding their interaction with the system, concentrating on the possible wrong moves or reactions they might perform. Legal risks include the risks that will arise if the system is not compliant with the legislation of the country. Finally, organisational risks refer to the organisational structure of the service chain, while technical risks are related to project-level technical concerns.

The overall process for calculating RPNs is depicted in the figure below (Figure 3):

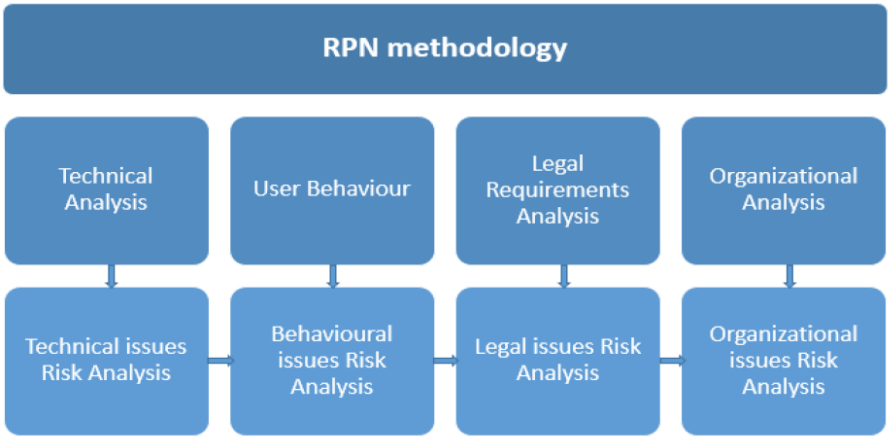

Figure 2 - Methodology for the estimation of Risk Priority Numbers

The Risk Priority Number (for each risk) is calculated by Eq. 1:

$RPN = S \times O \times (D + R) / 2$ **– Equation (1)**

Where

S = Severity

O = Occurrence

D = Detectability

R = Recoverability

Whilst many (E)FMEA are carried out by a team of experts, it is important to understand that the SYCLOPS consortium consists of partners from different countries working independently and so ways of achieving consistent results from all partners are required. The following checklist of 10 key points based upon the question "What can go wrong?" has been developed by Bluvband and Grabov6[4] to assist individuals in identifying possible Failure Modes:

- The intended function is not performed
- The intended function is performed, but there are some safety problems, or a problem in meeting a regulation associated with the intended function performance
- The intended function is performed, but at a wrong time (availability problems)
- The intended function is performed, but in the wrong place (position in the system)
- The intended function is performed, but in the wrong way (efficiency problems)
- The intended function is performed, but the performance level is lower than expected
- The intended function is performed, but its cost is higher than planned (additional maintenance, repair, power consumption etc.)
- An unintended/unplanned and/or undesirable function is performed
- The period of intended function performance (lifetime) is lower than planned (reliability issues)
- Support for the intended function performance is impossible or problematic (maintenance, repair, service issues etc.)

Based on the overall approach, the following tables have been developed to assist in identifying the level of each risk and the value that should be assigned in the RPN calculation.

Level of severity	Technical issue	Behavioural issue	Legal issues	Organisational issues
9-10 (extremely severe)	The failure could put user safety at risk, potentially causing injury or fatality	The user error in operating the system could lead to an incident worseness (i.e., safety effects)	Are there laws in each country that do not allow the system to be implemented?	Wide and different organisational framework is needed, that is completely missing (i.e., new services)
7-8 (severe)	The failure implies the total loss of the system functions, resulting in user's dissatisfaction	User behavioural error may abort the system benefits (i.e., safety effects due to changes in ways of acquiring info)	New laws are required for system implementation and no relevant work has been performed yet	Organisational framework adaptation is needed (some initial actions have been taken on this domain)
5-6 (slightly severe)	The failure implies the partial loss of	User's behavioural changes may	New laws are required for system	Organisational framework adaptation is

[4] Z.Bluvband, P. Grabov, Failure analysis of FMEA, "Reliability and Maintainability Symposium (RAMS), pp. 344 - 347 2009"

	the system function, resulting in user's dissatisfaction	significantly reduce the positive effects of the system	implementation and work required has already been performed	needed which has already started being realised
3-4 (significant)	The failure implies slight dissatisfaction to the user	User's behavioural changes may somehow influence the positive effects of the system	New laws are required for system implementation but consensus on them exist	There is a need for limited and easily realized organisational changes
1-2 (insignificant)	The failure does not imply perceptible effects to the system function and to the user's satisfaction	User's behaviour is not expected to reduce the system benefits significantly, or may even further enhance them	No new laws are required for implementation	There is no need at all for organisational changes

Table 12 - Severity (S) level analysis

Occurrence level	Technical issue	Behavioural issue	Legal issues	Organisational issue
9-10 (high)	It is certain that some failures will sometimes occur	It is certain that some behavioural effects will occur (by the system users)	It is certain that some legal problems will occur	It is certain that there will be a need for organisational restructuring
6-8 (medium)	A failure could occasionally occur	Some behavioural effects could occasionally occur	Some legal problems could occasionally occur	A need for organisational restructuring could occasionally occur (depending on the needs of the service, that will arise after the operation of the system)
3-5 (low)	There is only a slight probability that an error/failure will occur	There is only a slight probability that some behavioural effects will occur	There is only a slight probability that some legal problems will occur	There is only a slight probability that a need for organisational restructuring will occur
1-2 (improbable)	It is unlikely that a fault will occur	It is unlikely that some behavioural effects will occur	It is unlikely that some legal problems will occur	It is unlikely that organisational restructuring will occur

Table 13 - Occurrence (O) level analysis

Detectability level	Technical issue	Behavioural issue	Legal issue	Organisational issue
9-10 (improbable)	It is impossible or improbable that a problematic area will be detected	It is impossible or improbable that a user's behavioural effect will be detected	It is impossible or improbable that a legal problem will be detected	It is impossible or improbable that an organisational problem will be detected
7-8 (slight)	The problematic area is detected only in particular cases	The user's behavioural effect is detected only in particular cases	The legal problem is detected only in particular cases	The organisational problem is detected only in particular cases
5-6 (moderate)	It is probable that the problem will be detected (depending on the situation)	It is probable that the user's behavioural effect will be detected	It is probable that the legal problem will be detected	It is probable that the organisational problem will be detected
3-4 (high)	It is very probable that a problem will be detected	It is very probable that the user's behavioural effect will be detected	It is very probable that the legal problem will be detected	It is very probable that the organisational problem will be detected
1-2 (very high)	It is certain that a problem will be detected	It is certain that the user's behavioural effect will be detected	It is certain that the legal problem will be detected	It is certain that the organisational problem will be detected

Table 14 - Detectability (D) level analysis

Recoverability level	Technical issue	Behavioural issue	Legal issues	Organisational issues
9-10 (null)	No recovery action is provided	System is (in)flexible to user's behavioural effects	System is either accepted or rejected by the legal framework	System requires a fixed organisational environment to operate

6-8 (low)	The user is only advised on the failure	Behavioural effects are considered by the system	System may be slightly adapted to meet legal restrictions	System requires a fixed organisational framework with limited adaptations
3-5 (high)	Effective recovery action is provided	System customization might compensate for user's behavioural effects	System encompasses different versions to meet legal demands	System may operate within various organisational frameworks
1-2 (full recoverability)	The failure effect is completely avoided by the recovery action	System does not allow user's behavioural effects	System is easily reconfigurable to meet legal demands	System does not require organisational changes
Recoverability level	Technical issue	Behavioural issue	Legal issues	Organizational issues

Table 15 - Recoverability (R) level analysis

Using the values in the above tables, the appropriate RPN must be calculated for each identified risk item in the SYCLOPS system based on Equation (2):

$$TRE = \frac{\sum_{i=1}^{n} RPN_i}{1000n} \times 100\%$$

4.4.2 Identification of Total Risk Estimate and Critical Items

The calculation of the RPN for each item can highlight potentially problematic areas in which the developers are required to put more effort in to resolve (i.e., to offer mitigation strategies).

The value of each individual RPN calculated above is initially matched to five levels of severity, as defined in the following table (values are indicative only):

Calculated RPN	Overall severity
512-1000	I- Extremely severe
216-512	II- Severe
64-216	III – Moderate
8-64	IV – Slight
1-8	V – Insignificant

Table 16 – RPN and severity levels

It is also useful to calculate the Total Risk Estimate (TRE) for the overall project, as proposed by Bluvband and Grabov[5]

$$TRE = \frac{\sum_{i=1}^{n} RPN_i}{1000n} \times 100\%$$

where: RPN_i : individual RPN values for each item

n : total number of items in the EFMEA analysis.

TRE values range between 0.1% (no risk at all) and 100% (extremely risky), but it is unlikely that either of these extreme values will be obtained. Bluvband and Grabov suggest that any TRE above 17% indicates a "risky" project as this is where the individual T/B/L/ORPN values are 5.5 i.e. the middle of the 1 to 10 scale used in the tables, or higher.

4.5 SYCLOPS Expanded Failure Modes and Effects Analysis

The EFMEA was conducted considering various risks associated with SYCLOPS and RPN values were calculated for each risk based on the respective severity, occurrence, detectability, and recoverability values.

4.5.1 Risk Identification

The following tables present the major general, technological, organisational, behavioural, and legal identified project risks.

No	General Risk Description	Impact to WPs	S	O	D	R	RPN	Risk Level
1	Delay of key deliverables or milestones	ALL	6	4	2	3	60	4-Slight
3	Cross countries and cross development environments can result in hard integration and bad quality of achievements	ALL	6	3	3	4	63	4-Slight
4	Insufficient partner's Commitment and performance	ALL	5	5	2	3	62,5	4-Slight
5	Not performing Beneficiary	WP1, ALL	3	4	4	4	48	4-Slight
6	Lack of interest on the SYCLOPS project by external stakeholders	WP6, ALL	6	6	3	4	63	4-Slight
7	Use case validation fails to provide the anticipated results or turn out to be inadequate	WP2	7	7	3	6	189	3-Moderate
8	Reluctance to share data within an organization, as well as between organizations	ALL	3	3	2	6	72	3-Moderate

Table 17 - Initial General Risks and RPN Calculations

No	Technological Risk Description	Impact to WPs	S	O	D	R	RPN	Risk Level
1	Performance issues	WP2, WP3, WP4, WP5	7	7	2	5	180	3-Moderate
2	The delivery times of components required for the testing and use case implementation are too long to reach on time for prototyping and testing.	WP2, WP3, WP4, WP5	6	5	2	5	72	3-Moderate
3	The use case definition could result in use cases which cannot be fully technically	WP2	7	2	2	7	175	3-Moderate

[5] Z .Bluvband, P. Grabov, Failure analysis of FMEA, "Reliability and Maintainability Symposium (RAMS), pp. 344 - 347 2009

	implemented.							
4	Scalability and modularity requirements not clearly defined	WP2	7	2	2	7	70	4-Slight
6	Disagreement on the overall architecture design	WP2	8	2	2	2	96	3-Moderate
7	Delays in the development because of technologic capabilities	WP2,WP3, WP4, WP5	8	4	3	3	96	4-Slight

Table 18 - Technological Risks and RPN Calculations

No	Managerial/Org Risk Description	Impact to WPs	S	O	D	R	RPN	Risk Level
2	Key partner leaving the project and/or temporary unavailability due to health reasons	ALL	8	1	1	2	75	4-Slight
3	Poor communication and cooperation between the consortium members	ALL	5	4	2	3	50	4-Slight
4	Unrealistic project time schedule and deadlines	ALL	6	2	2	2	144	3-Moderate
5	Discouragement to travel (due, for instance, by competent authorities' decision at national/EU level)	WP1, ALL	4	6	2	4	40	4-Slight
6	Disputes between work packages	WP1	5	2	2	2	30	4-Slight
7	Budget misalignments	WP1	4	3	3	3	36	4-Slight

Table 19 - Managerial Risks and RPN Calculations

No	Behavioral/Legal/Exploitation Risk Description	Impact to WPs	S	O	D	R	RPN	Risk Level
1	Personnel behavioural issues	ALL	7	4	5	1	84	3-Moderate
2	Disputes over ownership of IPR amongst consortium partners	WP6	7	4	5	5	154	4 - Slight

Table 20 - Behavioral Risks and RPN Calculations

Based on the aforementioned tables and Equation (2), the Total Risk Estimate value is:

TRE = 7.54%

This value is lower than 17%, thus according to Bluvband and Grabov it suggests that SYCLOPS is not a risky project. However, this value can be further reduced (diminishing even more possible risk effects) if appropriate mitigation strategies are considered.

4.5.2 Risk Mitigation

The core philosophy of the risk management strategy and problem handling relies on prevention. A problematic situation will be addressed as soon as possible and at the lowest possible level, while it is brought to the immediate attention of the PC. The risk management and contingency plan, as well as the Quality and Risk Management Plan will be handled both at a WP level, as well as centrally within WP1. The risks related to the activities of each WP will be eventually recognized through dedicated sessions. The critical risks that have been currently identified by the Consortium along with the respective contingency plans are provided in page 23 of the SYCLOPS Grant Agreement. During the project there will be a constant and iterative activity identifying new risks and then ensuring that the necessary mitigation strategies will be determined and applied.

Finally, it should be underlined that the Risk Assessment and Mitigation Planning is an ongoing process throughout the project's lifecycle. Having that in mind and taking into consideration the problems that may occur if extra risks are revealed, SYCLOPS' risk management will be ongoing to identify and appropriately address potential arising risks.

Annex A

SYCLOPS main contact points per partner

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