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Dissemination and Communication Report-v1

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Terms and Abbreviations

AI	Artificial Intelligence
CRA	Cyber Resilience Act
DoA	Description of Action
DORA	Digital Operational Resilience Act
EAB	External Advisory Board
EC3	European Cluster for Cybersecurity Certification
ECCO	European Cybersecurity COMMunity support project
EU	European Union
ETSI	European Telecommunications Standards Institute
IoT	Internet of Things
KPI	Key Performance Indicator
OSCAL	Open Security Controls Assessment Language
SEO	Search Engine Optimization
SME	Small and Medium Enterprise
WIP	Work In Progress
WP	Work Package

Executive Summary

This deliverable (D6.4) is a public report describing some of the activities undertaken as part of Work Package 6 “Dissemination, exploitation, and communication” during the first eighteen months of the project. In particular, this document is the first of two deliverables that explain the dissemination and communication activities carried out during each reporting period along with the results achieved. In addition, this document includes relevant activities carried out to promote collaboration with EMERALD-related projects, as well as presents future plans for networking.

The communication, dissemination, and networking activities carried out during the first eighteen months of the project followed the plan defined in deliverable D6.2 [1] (M6), and the Key Performance Indicators (KPIs) established therein were mostly achieved.

The project’s communication activities have been successfully implemented through various dissemination materials, including flyers and press releases. Additionally, blog posts related to the project’s activities have been published on the project’s website and shared on social media to enhance its visibility. Social media platforms such as X, LinkedIn, and YouTube have also been used to promote the project. The impact of the website has been evaluated using Google Analytics tools to monitor engagement and behaviour, providing insights on its effectiveness.

Dissemination activities have been carried out to engage both scientific and industrial communities. These efforts include publishing scientific results in journals and conferences, collaborating with similar projects and initiatives, and participating in panels, seminars, lectures, workshops, and webinars, in which EMERALD was presented. In addition, specific tools have been developed to ensure effective dissemination, including posters, presentations and news brochures.

As part of a broader networking strategy, we set up a collaboration with an External Advisory Board (EAB), a group of external experts that provides essential advice throughout the project's duration. Other networking activities include the connection with several European projects addressing similar topics, such as certification, cloud computing, and cybersecurity. These efforts include workshops, webinars, and the formation of a European Cluster for Cybersecurity Certification (EC3), which was presented at a panel during the CLOSER 2025 International Conference.

A follow-up document for this deliverable, D6.5 [2], will be produced in month 36 on dissemination, communication, and networking activities carried out during the second reporting period. In addition, it will provide consolidated project-wide data, including key performance indicators (KPIs) and analytics covering the full duration of the project.

1 Introduction

The objective of Work Package 6, “Dissemination, exploitation and communication” is to maximize the project's impact by ensuring effective communication, dissemination, and exploitation of its results, as well as contributing to relevant standardization efforts. These activities aim to raise awareness among scientific, industrial, and general public audiences and foster the adoption of the project's outcomes.

This deliverable focuses specifically on communication, dissemination, and networking activities, in line with the objectives set in D6.2 [1], which defined the strategy for these actions. A follow-up document, D6.5 [2], will be published at the end of the project. Aspects related to exploitation and standardization are addressed in a separate deliverable, D6.6 [3].

1.1 About this deliverable

This deliverable provides a detailed account of the dissemination, communication, and networking activities carried out during the first eighteen months of the project. Its primary goal is to document the progress made in raising awareness about the project, engaging with relevant stakeholders, and fostering collaboration within the scientific and industrial communities. The deliverable outlines the initial objectives set in the Description of Action (DoA) [4] and the deliverable D6.2 [1], presenting the achievements reached so far while assessing their alignment with the defined KPIs. Additionally, it highlights any deviations from the original plan and discusses the strategies implemented to address them.

The whole EMERALD consortium has played a key role in executing these activities, leveraging its diverse expertise and networks to maximize the project's visibility and impact. Each partner has actively contributed by participating in conferences, publishing research findings, organizing events, and engaging with external stakeholders to ensure effective knowledge dissemination and long-term sustainability of the project's outcomes.

1.2 Document structure

This document is structured as follows:

- Section 1 provides a general introduction, outlining the scope and structure of this deliverable.
- Section 2 presents a summary of the key results achieved in dissemination, communication, and networking activities.
- Section 3 focuses on the project's branding and visual identity, detailing the development of the project logo, the colour palette, and the overall design guidelines that ensure consistency across all communication materials.
- Section 4 describes the communication strategy adopted during the first reporting period. It includes an overview of the digital strategy, covering the project website, blog, and web analytics used to monitor engagement. It also highlights the project's presence on social media platforms such as X¹, LinkedIn², and YouTube³, and describes the creation of various communication materials, including flyers and press releases.
- Section 5 covers dissemination activities, providing an overview of scientific publications produced by project partners and news articles published on the project's website. It also includes details on the creation of posters and their presentation at dedicated venues, as well as participation in key events where the project has been promoted.

¹ <https://x.com/EmeraldHEproj>

² <https://www.linkedin.com/company/emerald-he-project/>

³ <https://www.youtube.com/@emerald-he-project>

Furthermore, it describes the general EMERALD presentation created to promote the project at conferences, seminars, and workshops, along with references to the project from the broader research and industry community.

- Section 6 describes networking efforts, detailing collaboration with the EAB and its role in providing strategic guidance to the consortium. It also outlines networking activities carried out with other European projects working on related topics and describes engagement with other relevant initiatives beyond EU-funded projects.
- Section 7 reports on the progress made towards the defined KPIs and outlines the roadmap for the next phase of the project, aiming to further enhance the effectiveness of dissemination, communication, and networking activities.
- Section 8 presents the conclusions of this deliverable, summarizing key achievements and outlining future directions.
- Finally, the Appendices provide a comprehensive collection of materials produced to support the project's dissemination and communication strategy. These include a variety of resources such as a flyer, press releases, a brochure, posters, and presentation slides, all of which have been used to promote the project's goals, activities, and outcomes to different target audiences.

2 Global Progress and Results

This section summarizes the results achieved in terms of communication, dissemination, and networking activities during the first eighteen months of the EMERALD project.

2.1 Communication Results

The communication activities conducted within the EMERALD project primarily target a broad range of users, including researchers, industry professionals, policymakers, and the general public, with an interest in cybersecurity, cloud computing, and certification. These groups are crucial for raising awareness of the project's objectives and fostering a wider understanding of its impact.

To achieve these goals, during the first reporting period of the project, various communication channels were employed to raise awareness of the EMERALD project and its preliminary results. The objective was twofold: to facilitate the implementation of project activities and to keep stakeholders and interested parties informed about the project's progress and the potential impact of its outcomes.

Multiple communication tools were used for this purpose (see Section 4.1), first and foremost the official EMERALD project's website⁴, which acts as the main platform for sharing updates and resources and has been visited approximately 2,500 times as of the end of April 2025.

One of its key features is the "EMERALD fragments", a blog-style section that is regularly updated with posts presenting insights, progress highlights, and reflections on the project (see Section 4.1.2). To date, 39 "fragments" have been published, therefore, this section of the website represents a kind of online diary to which all partners contribute to keep users informed about technologies, solutions adopted, problems encountered, and any other relevant news that occur during the project. These, along with updates shared on social media platforms, have been instrumental in engaging the public and stakeholders. Several project materials have been provided such as a first flyer (see Section 4.3), three press releases, three posters, one project presentation and two videos. All this material is useful to give an overview of the project, its objectives, results and to keep the general public and interested stakeholders informed about the activities carried out in EMERALD.

The EMERALD social media channels have been used to reach a wider audience. Their use has increased communication effectiveness and interaction with the target communities, with other research projects, and with the public. The social media channels adopted by the project are X, LinkedIn and YouTube (see Section 4.2), where 55 and 48 posts, and 2 videos were published, respectively.

Additionally, the project has produced a flyer (see Section 4.3), the first in a series of three, designed to raise awareness about EMERALD and present key project information in a simple and engaging way. The flyer also highlights the project's innovative approach to evidence management for Continuous Certification in Cloud Services and encourages readers to visit the project website for further details.

Several press releases have also been produced to reach both general and specialized media outlets, with the aim of providing details of the project's objectives (see Section 4.4). In particular, an official press release was released by the consortium, and two additional press releases were published by the partners.

⁴ <https://www.emerald-he.eu/>

Furthermore, two initial videos have been published on the project's YouTube channel and linked in a dedicated section of the website, to offer a dynamic and accessible way of showcasing the project's activities, results, and impact.

Finally, a wide coverage of the project General Assemblies that are periodically hosted by the various project partners, has been given by the project's communication channels both through the publication of dedicated fragments on the website and through posts on the project's main social media channels. This has contributed to spread the project's goals and results, the significant milestones achieved, the progress on technical work packages and project deliverables, the networking activities put in place and any other news about EMERALD which is noteworthy for the public.

2.2 Dissemination Results

The primary target users of the dissemination activities conducted within the EMERALD project include researchers, industry professionals, policymakers, and stakeholders in the fields of cybersecurity, cloud computing, and certification. These groups are key to the project's success as they directly influence the advancement of the knowledge and technologies developed within EMERALD. The dissemination efforts are tailored to engage these users with relevant findings and ensure that the project's outputs are effectively communicated to those who can leverage the results for further research, policy development, and practical applications in the industry.

During the first eighteen months of the EMERALD project, significant efforts have been devoted to scientific dissemination, resulting in several academic publications. Specifically, one research paper **“Blockchain-Based Evidence Trustworthiness System in Certification”**⁵ has been published in the *Journal of Cybersecurity and Privacy*, while four papers have been presented at prestigious international conferences and workshops. Specifically, **“CertGraph: Towards a Comprehensive Knowledge Graph for Cloud Security Certifications”**⁶ was presented at the *ACM/IEEE 27th International Conference on Model Driven Engineering Languages and Systems*, **“owl2proto: Enabling Semantic Processing in Modern Cloud Micro-Services”**⁷ was presented at the *16th International Conference on Knowledge Engineering and Ontology Development*, **“Automatic association of quality requirements and quantifiable metrics for cloud security certification”**⁸ was presented at the *4th Italian Workshop on Artificial Intelligence and Applications for Business and Industries*, and **“EMERALD: Evidence Management for Continuous Certification as a Service in the Cloud”**⁹ was presented at the *15th International Conference on Cloud Computing and Services Science*. These publications contribute to the advancement of knowledge in areas relevant to EMERALD and reflect the project's commitment to promoting scientific excellence and engagement with the wider research community. A comprehensive list of publications, along with other dissemination activities, is provided in Section 5.1.

The consortium has actively participated in various events to promote the project's objectives and findings. These include conferences, workshops, and industry events where partners have presented research results, engaged with stakeholders, and discussed EMERALD's contributions to cybersecurity and cloud certification. Additionally, project results have been (and will be) disseminated through academic seminars and upcoming presentations at major conferences, workshops, and industry events. A full list of events attended by EMERALD partners can be found in Section 5.5.

⁵ <https://www.mdpi.com/2624-800X/5/1/1>

⁶ <https://doi.org/10.1145/3652620.3687795>

⁷ <https://doi.org/10.48550/arXiv.2411.06562>

⁸ <https://arxiv.org/abs/2503.09460>

⁹ <https://doi.org/10.48550/arXiv.2502.07330>

To support dissemination activities, the consortium has developed a range of materials and tools to facilitate engagement with different target users. A key resource has been the first annual summary (see Section 5.2), which provides a detailed overview of progress in each work package, giving stakeholders a clear picture of the project's progress. In addition, three posters were produced to visually summarise the key results (see Section 5.3): a general poster highlighting the main results of the first year, a second poster tailored for an event dedicated to European projects, and a third poster developed by a partner to be presented at the *ACM/IEEE 27th International Conference on Model Driven Engineering Languages and Systems*.

Beyond static materials, EMERALD has also invested in dynamic content, producing presentations (see Section 5.6) and showcase videos (see Section 5.4) to increase accessibility and outreach. The first video¹⁰, created by the consortium, introduces the public to EMERALD's objectives and impact, while a second video¹¹, developed by the partner SCCH, offers a more detailed explanation of their specific role within the project. These materials have been instrumental in enhancing visibility and fostering engagement across different dissemination channels.

As a result of the project's dissemination, communication, and networking efforts, EMERALD has gained increasing recognition within the cybersecurity and cloud certification communities. Over the course of the project, approximately 1,500 people have been reached through conferences, workshops, and online activities. Notably, EMERALD participated in the Hannover Messe, a leading industrial trade fair held from April 22 to April 26, 2024, in Hannover, Germany, which typically attracts around 130,000 visitors and over 4,000 exhibitors.¹² Additionally, the project's website has received over 2,500 visits since its launch. Other organizations and European projects have taken note of EMERALD's contributions, resulting in invitations to participate in discussions, collaborations and demonstrations of the project's results (see Section 5.7). This visibility reinforces EMERALD's role as a key player in shaping the future of cybersecurity certification and fosters new opportunities for synergies with ongoing initiatives at European level.

2.3 Networking Results

The primary target users for the networking activities conducted within the EMERALD project include key industry professionals, researchers, policymakers, and other stakeholders from the cybersecurity, cloud computing, and certification sectors. Unlike dissemination activities, which aim to broadly share knowledge and raise awareness, networking activities are specifically designed to foster deeper collaborations and strategic partnerships among professionals and organizations. By engaging with these target users, the project aims to create valuable connections, stimulate future collaborations, and directly influence the development and adoption of innovative solutions within the industry (see Section 6).

EMERALD has developed connections with several European projects, fostering joint activities such as participation in working groups, webinars, and technical exchanges. Notable collaborations include COBALT¹³, CERTIFAI¹⁴, CERTIFY¹⁵, DOSS¹⁶, TELEMETRY¹⁷, and

¹⁰ <https://www.youtube.com/watch?v=ISLq-R6Dm5Q>

¹¹ https://www.youtube.com/watch?v=8haWlNtr_Tg

¹² https://www.heise.de/en/news/Hannover-Messe-2024-endet-mit-stabiler-Besucherzahl-9700530.html?utm_source=chatgpt.com

¹³ <https://horizon-cobalt.eu/>

¹⁴ <https://certifai.info/>

¹⁵ <https://certify-project.eu/>

¹⁶ <https://dossproject.eu/>

¹⁷ <https://telemetry-project.eu/>

CONFIRMATE¹⁸, among others. In this regard, a major milestone has been EMERALD's role in the formation of the European Cluster for Cybersecurity Certification¹⁹, which aims to unify research and innovation efforts in agile certification (see Section 6.1). The cluster facilitates technical collaboration through joint publications, research roadmaps, and open-source engagement while also driving dissemination efforts through workshops and whitepapers. EMERALD has led the launch of the Cluster's official website and its presentation at the CLOSER 2025 conference²⁰. The Cluster has also initiated the creation of a shared repository for security metrics, further supporting interoperability in cybersecurity certification.

Additionally, EMERALD has engaged with broader cybersecurity initiatives, including Gaia-X²¹, the European Telecommunications Standards Institute (ETSI)²² and the EU Alliance for Industrial Data, Edge and Cloud²³, to align its research with ongoing European efforts.

Finally, a key achievement has been the establishment of an EAB, composed of experts from academia, industry, and standardization bodies, providing strategic guidance on cloud certification.

¹⁸ <https://www.linkedin.com/company/confirmate-project/>

¹⁹ <https://cybersecuritycertcluster.eu/>

²⁰ <https://closer.scitevents.org/panel.aspx#1>

²¹ <https://gaia-x.eu/>

²² <https://www.etsi.org/>

²³ <https://digital-strategy.ec.europa.eu/en/policies/cloud-alliance>

3 Branding and Visual Identity

Branding and visual identity are crucial elements in establishing a strong and recognizable presence for a project. This section outlines the key communication materials developed to define and reinforce the project's visual identity, ensuring consistency across all project-related documents, such as reports, flyers, posters, presentation slides, and news. The goal is to create a professional and cohesive appearance that enhances visibility and recognition throughout the duration of the project. These materials will be updated and refined as the project evolves.

3.1 Project Logo

The logo is the primary element of the visual identity and a key component in building an effective dissemination campaign. The project logo (see Figure 1) is featured on all graphic materials and documents related to the project, clearly representing the core concepts and vision of EMERALD. Its design is intended to reflect the project's fundamental values and ensures immediate recognition across all communication platforms.



Figure 1. EMERALD project primary logo

In addition to the main version, the EMERALD logo is available in several formats and alternative designs to accommodate different communication needs and media. Figure 2 provides examples of alternative logo versions, including horizontal and stacked arrangements of the icon and wordmark, as well as both full-colour and monochrome styles.

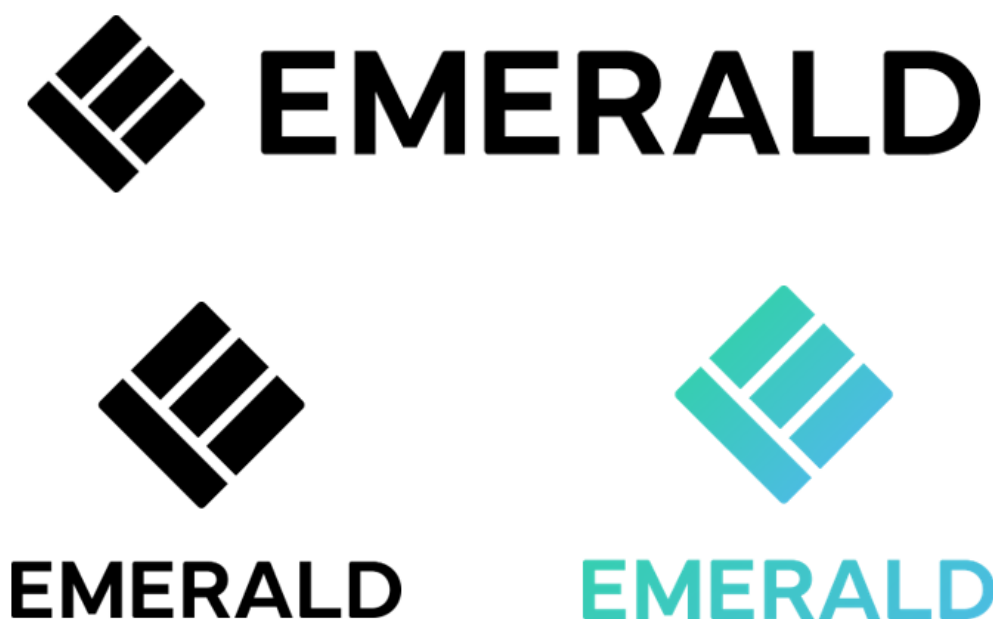


Figure 2. Variants of the EMERALD logo, showing different layouts

3.2 Project Palette

The EMERALD colour palette features a combination of vibrant and pastel hues that embody the project's brand identity (see Figure 3). It includes a bright turquoise green, a soft yellow, a vivid orange, a subtle coral, and a sky-blue shade. Each primary colour is accompanied by variations of reduced saturation (80%, 70%, 40%, 35%, and 20%), creating a gradient effect that offers flexible options for branding and design applications. This palette has already been introduced in deliverable D6.1 [5].

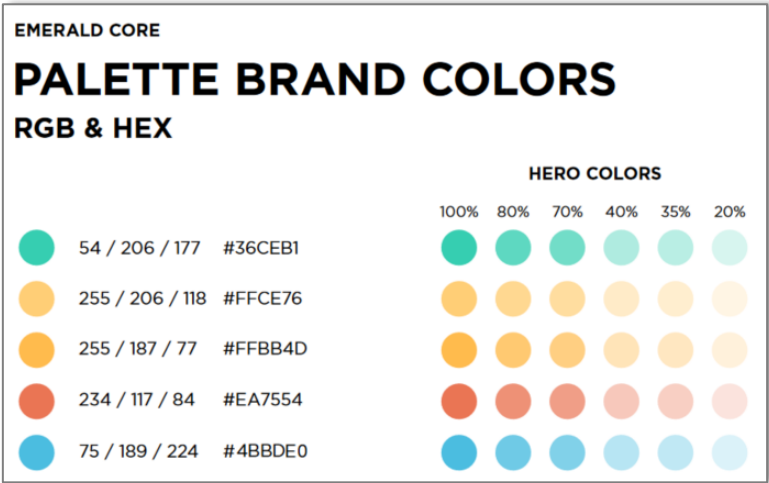


Figure 3. EMERALD colour palette

4 Communication Activities

This section reports the results of the communication activities conducted during the first eighteen months of the EMERALD project. The revision of the communication KPIs can be found in Section 7.1.

Communication activities focus on the implementation of a comprehensive strategy to promote the project's progress and results. These activities include the development and management of the project website, the production of communication materials such as project fragments, flyers, social media posts, videos and press releases. These will help in providing targeted information to multiple audience, including the scientific community, commercial stakeholders, and general citizens.

4.1 Digital Strategy

EMERALD's digital strategy is based on the use of user-driven online platforms and digital data to inform and implement online communication aimed at adequately highlighting the project's objectives and activities.

Several different tools have been used to implement the project's digital strategy, including the project website, the "EMERALD fragments", and the social media channels, with a special focus on X and LinkedIn. The social media profiles are also used for the dual purpose of attracting stakeholders and the general public to the website and its content. Every time a fragment is published on the website, it is also promoted on X and LinkedIn, accompanied by a link to the content.

4.1.1 Project Website

The EMERALD website is active since February 2024, and it is available at the following link: <https://www.emerald-he.eu/>. It was set up at the beginning of the project and has been an efficient tool for reporting the EMERALD project activities, as well as for communicating with people outside the project.

The goal of the EMERALD website is twofold: first, it is used for short, targeted messages, presenting the project and its activities in a friendly manner. Second, it acts as a platform to share the project's results and materials (such as deliverables, communication tools, publications, and more).

The website's structure is organized in different sections, and provides stakeholders with information on the project organization, vision, solution approach, objectives, key results and benefits. Figure 4 shows the homepage of the EMERALD website, including the main menu with the different sections: "About", "Pilots", "Resources", "Communication", "EMERALD Fragments", and "Contact".

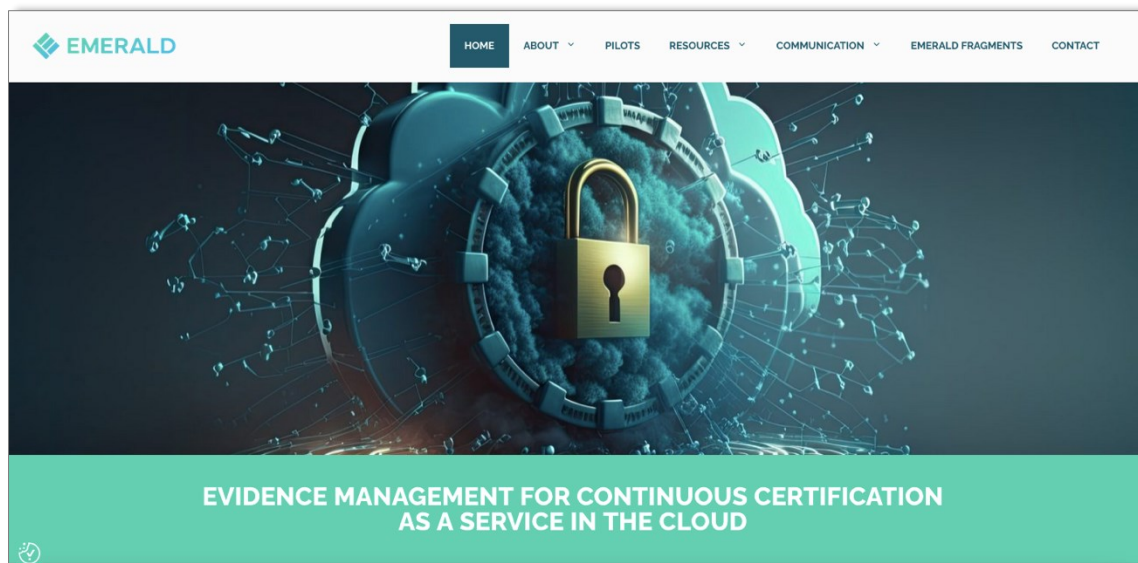


Figure 4. Homepage of the EMERALD website

- The **“About” section** provides general information about the project mission, approach, objectives, key results, and tools. It also includes information about the 11 project partners with a brief description of their mission and a link to their institutional website.
- The **“Pilots” section** includes the description of two categories of pilots that have inspired the EMERALD mission.
- The **“Resources” section** contains several useful resources, since it allows users to consult public deliverables, publications, information about networking activities and other open resources.
- The **“Communication” section** gives access to several sub-sections dedicated to flyers, press releases, posters, videos, annual summaries and presentations, where different materials used for the dissemination and communication activities are available.
- The **“EMERALD Fragments” section** includes brief posts written by the EMERALD partners to allow users to follow the project activities and progress.
- Finally, the **“Contact” section** shows the contact details of the project coordinator.

The website is constantly updated with data and content contributed by all partners as the project progresses.

The initial structure of the website was presented in D6.1 [5] and is still valid, except for the sub-section (inside **“Resources”**) originally named **“Synergies”**, which has been changed to **“Networking”**.

4.1.2 EMERALD Fragments

EMERALD fragments have been published on a dedicated page of the website²⁴. Fragments represent pieces of information written in a simple and straightforward style, enriched with images and links to additional content and to the detailed page of the website (see Figure 5).

Depending on the type of content, the published fragments are divided into the following categories to make it easier for the reader to find news about the project:

- Communication
- Deliverables

²⁴ <https://www.emerald-he.eu/emerald-fragments/>

- Events
- Meetings
- Networking
- Technical advancements

Fragments are published monthly, with contributions from all the partners. A “Social media/Fragments Rotation Schedule” has been defined (see Figure 6) to help the communication team to maintain a consistent flow of content, ensuring that enough posts are made to hold the attention of the audience.

The content of the fragments is freely selected by the authors/partners, with the aim of deepening certain aspects of the project that are particularly relevant to the partners' tasks (e.g., use cases, architectures, frameworks, risk analysis tools, cloud services, etc.). The EMERALD fragments are promoted on the project's social media (X and LinkedIn) to disseminate the project's activities (see Section 4.2). Figure 7 shows as an example the page of a fragment discussing the EMERALD personas developed within WP4.

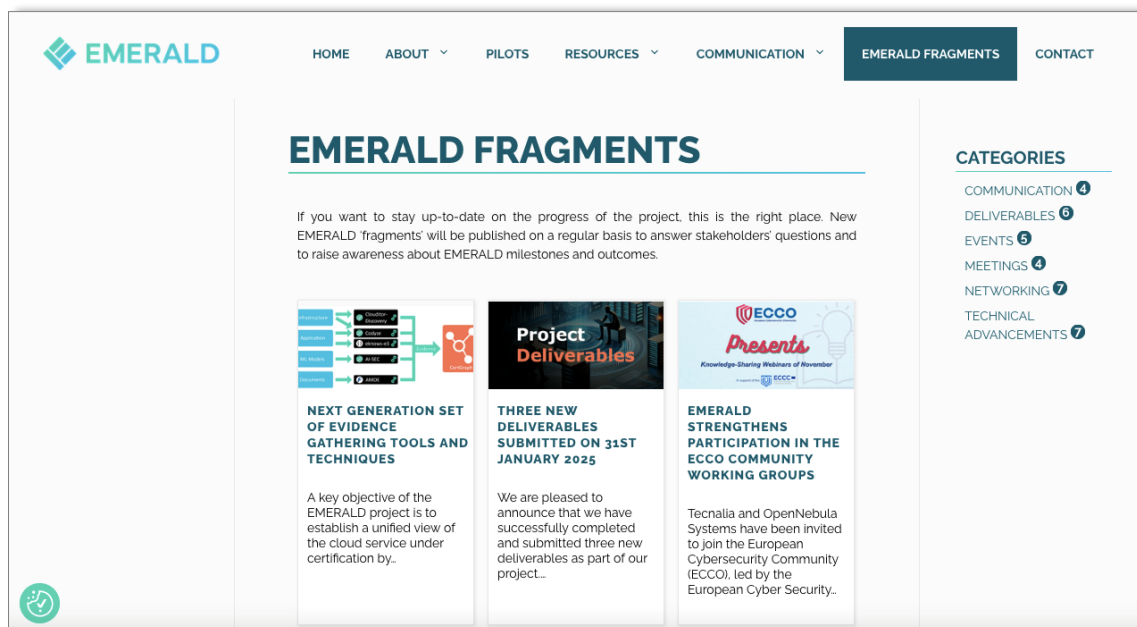


Figure 5. EMERALD fragments page

2024												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Partner	Responsible	Responsible	Responsible	Responsible	Responsible	Responsible	Responsible	Responsible	Responsible	Responsible	Responsible	Responsible
Partner	-	-	-	CNR	FABASOFT	CF	IONOS		CXB	ONS	NIXU	TECNALIA
Partner				IONOS	TECNALIA	KNOW	SCCH		FABASOFT	CNR	CF	CXB
2025												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Partner	Responsible	Responsible	Responsible	Responsible	Responsible	Responsible	Responsible	Responsible	Responsible	Responsible	Responsible	Responsible
Partner	KNOW	SCCH	TECNALIA	FHG	CNR	FHG	TECNALIA		FABASOFT	FHG	SCCH	FHG
Partner	ONS	NIXU	IONOS	CF	ONS	NIXU	SCCH		CNR	KNOW	TECNALIA	FABASOFT
2026												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct		
Partner	Responsible	Responsible	Responsible	Responsible	Responsible	Responsible	Responsible	Responsible	Responsible	Responsible		
Partner	KNOW	TECNALIA	CNR	FABASOFT	IONOS	ONS	CXB		CF	NIXU		
Partner	CXB	ONS	NIXU	FHG	SCCH	CF	KNOW		IONOS	CXB		

Figure 6. Social media/Fragments Rotation Schedule

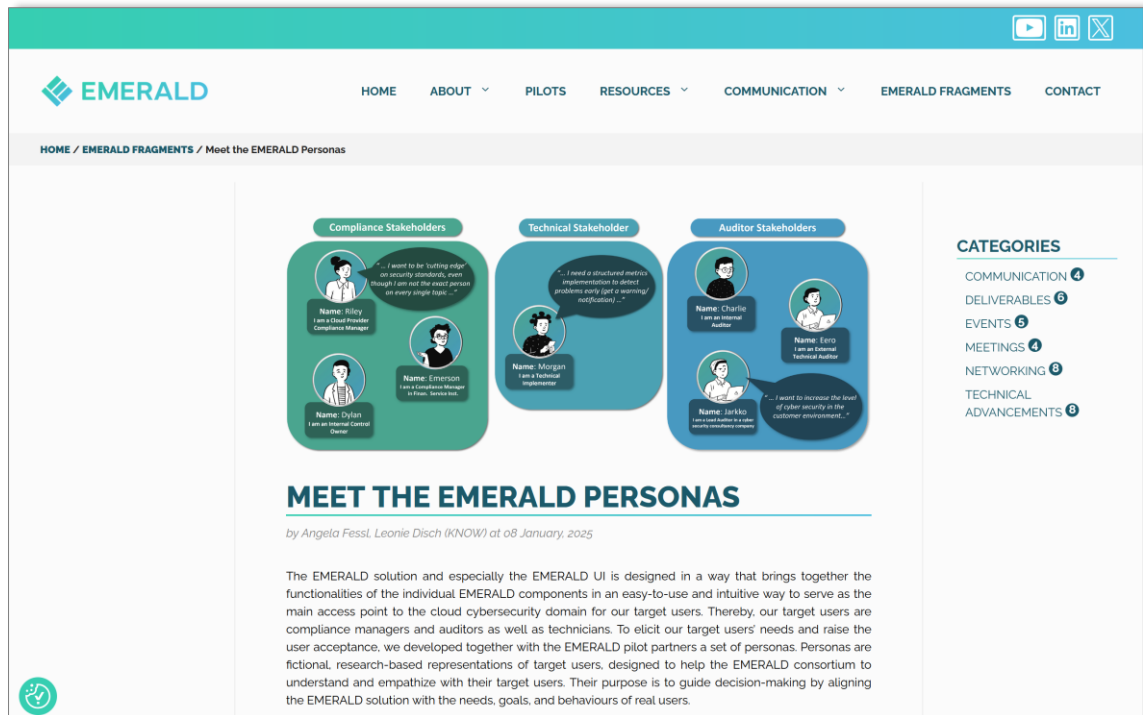


Figure 7. An example of an EMERALD fragment

During the first eighteen months of the project, 39 fragments have been posted in the “EMERALD Fragments” section. Table 1 shows the title, main author, and date of release of each fragment, as well as the direct link to the content on the website.

Table 1. EMERALD fragments published until M18 of the project

Title of the post	Author (Institution)	Date
Launch of the Security Metric Repository	Nico Haas (Fraunhofer)	16.04.2025
Pilot 2 – Workflow overview	Natalia Sobieska (CloudFerro)	11.04.2025
The EMERALD consortium met in Pisa for the 5th General Assembly	Adriana Lazzaroni (CNR)	09.04.2025
The European Cluster for Cybersecurity Certification: Enhancing Cybersecurity in the European Region	Cristina Martinez (TECNALIA), Juncal Alonso (TECNALIA)	28.03.2025
Compliance Managers' feedback of EMERALD UI and workflows	Mika Leskinen (NIXU), Samu Nisula (NIXU)	28.02.2025
Next Generation Set of Evidence Gathering Tools and Techniques	Somayeh Kargar (SCCH)	20.02.2025
Three new deliverables submitted on 31st January 2025	Michela Fazzolari (CNR)	10.02.2025
EMERALD strengthens participation in the ECCO community working groups	Jordi Guijarro (ONS)	29.01.2025
Meet the EMERALD Personas	Angela Fessler, Leonie Disch (KNOW)	08.01.2025
EMERALD's Innovative Approach to Compliance	Marti Fabregat (CXB)	20.12.2024

Title of the post	Author (Institution)	Date
Nixu's Role in EMERALD: Auditors Perspective and Stage-Gate Process	Antti Kantero (NIXU)	30.11.2024
EMERALD was present in the 12th Conference of the EU Framework Programme for R&D in Spain representing one of the Cluster 3 projects	Juncal Alonso (TECNALIA)	18.12.2024
Discover the New Resources from the EMERALD Project: Annual Summary and 1st Year Results Poster	Michela Fazzolari (CNR)	01.12.2024
Pilot 2 – test environments preparation	Natalia Sobieska (CF)	22.11.2024
Seven new EMERALD Deliverables submitted on 31st October 2024	Adriana Lazzaroni (CNR)	31.10.2024
The success of the 4th EMERALD HE Project General Assembly in Barcelona	Michela Fazzolari (CNR)	07.11.2024
The role of OpenNebula for the Multicloud Security Certification Challenges of Emerald	Jordi Guijarro (ONS)	04.11.2024
CaixaBank's Role in EMERALD: Enhancing Compliance in Hybrid Cloud-Edge Environments	Marti Fabregat (CXB)	08.10.2024
EMERALD YouTube channel	Adriana Lazzaroni (CNR)	30.09.2024
EMERALD pilots and DORA	Björn Fanta (FABA)	27.09.2024
Five EMERALD deliverables submitted in July 2024	Adriana Lazzaroni (CNR)	11.09.2024
CertGraph Ontology	Stefan Schoeberl (SCCH)	25.07.2024
The 3rd successful General Assembly of the EMERALD project took place in Karlsruhe	Michela Fazzolari (CNR)	02.07.2024
Pilot 2 description – CloudFerro's role in EMERALD	Natalia Sobieska (CF)	28.06.2024
EMERALD Introduced at "Hannover Messe 2024"	Netsanet Haile Gebreyesus (IONOS)	10.06.2024
Getting to know the EMERALD Pilots	Angela Fessl (KNOW)	03.06.2024
DevOps methodology and CI/CD strategy for EMERALD	Cristina Martinez (TECNALIA)	31.05.2024
EMERALD Data Diagram	Franz Deimling (FABA)	15.05.2024
EMERALD deliverables published in April 2024	Adriana Lazzaroni (CNR)	13.05.2024
EMERALD and CERTIFAI projects explore possible areas of joint work	Cristina Martinez (TECNALIA)	29.04.2024
EMERALD general presentation has been published	Michela Fazzolari (CNR)	02.04.2024
EMERALD at Bitkom's Expert Group on Cloud Services & Digital Ecosystems	Michela Fazzolari (CNR) & Björn Fanta (FABA)	27.03.2024
EMERALD Deliverable D6.1 published in February 2024	Adriana Lazzaroni (CNR)	14.03.2024
EMERALD and COBALT Projects explore new collaborations	Michela Fazzolari (CNR)	12.03.2024

Title of the post	Author (Institution)	Date
The EMERALD consortium met in Bilbao for the 2nd General Assembly	Adriana Lazzaroni (CNR)	11.03.2024
The first EMERALD Press release is now available	Adriana Lazzaroni (CNR)	28.02.2024
The first EMERALD Flyer is released	Adriana Lazzaroni (CNR)	15.02.2024
EMERALD presented at Annual CNR-IIT Conference in Pisa	Marinella Petrocchi (CNR)	16.01.2024
EMERALD Kickoff Meeting	Michela Fazzolari (CNR)	10.01.2024

4.1.3 Websites analytics

The EMERALD website uses the third-party plugin WP Statistics²⁵ to monitor website activities. According to the analytics data collected as of the end of April 2025 (see Figure 8), the total number of visits to the EMERALD website is about 2,500. Throughout the whole period of operation of the website, EMERALD has maintained a stable number of daily users, with increases observed whenever relevant activities occur, such as the publication of a “fragment” post.

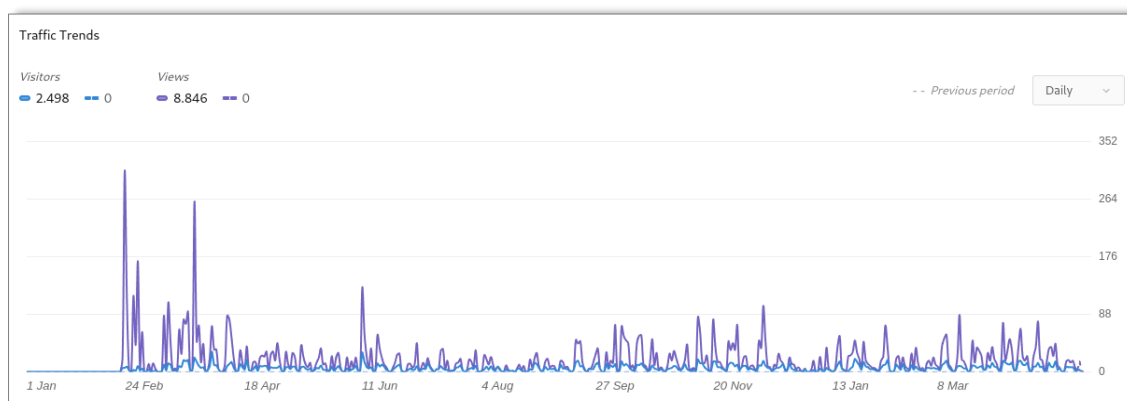


Figure 8. EMERALD website analytics from January 2024 to April 2025

As mentioned above, “fragment” posts often mark the highest number of visits to the EMERALD website. This trend is confirmed by the fact that the “EMERALD fragment” section is the second most visited page after the homepage, with 15.6% (1,382 views) of visitors accessing it directly (see Figure 9).

²⁵ <https://it.wordpress.org/plugins/wp-statistics/>

Content	Visitors	Views	Words	Published Date
HOME	1,274	3,590	262	11 December 2023 at 16:46
EMERALD FRAGMENTS	399	1,382	216	11 December 2023 at 16:48
DELIVERABLES	214	527	270	21 December 2023 at 16:04
PARTNERS	200	762	1,479	11 December 2023 at 16:47
PILOTS	150	368	290	30 January 2024 at 11:52
MISSION	116	429	132	20 December 2023 at 14:46
ANNUAL SUMMARIES	96	185	17	21 December 2023 at 16:12
PUBLICATIONS	88	202	152	21 December 2023 at 16:04
OBJECTIVES	68	147	280	21 February 2024 at 14:52
PRESS RELEASES	63	245	1	24 January 2024 at 14:25
NETWORKING	62	195	1	21 December 2023 at 16:05
KEY RESULTS	57	284	549	20 December 2023 at 14:56

Figure 9. Most visited pages of the EMERALD website

Regarding the geographical distribution of EMERALD's audience, the countries with the highest number of visitors are Italy, Austria and Spain, as shown in and Figure 11. This is also likely due to the presence of project partners based in these countries, which naturally boosts local engagement and visibility. Furthermore, the publication of the press release in multiple languages, namely English, Italian, Finnish, Polish, German and Spanish, has probably contributed to increase the traffic from different countries.

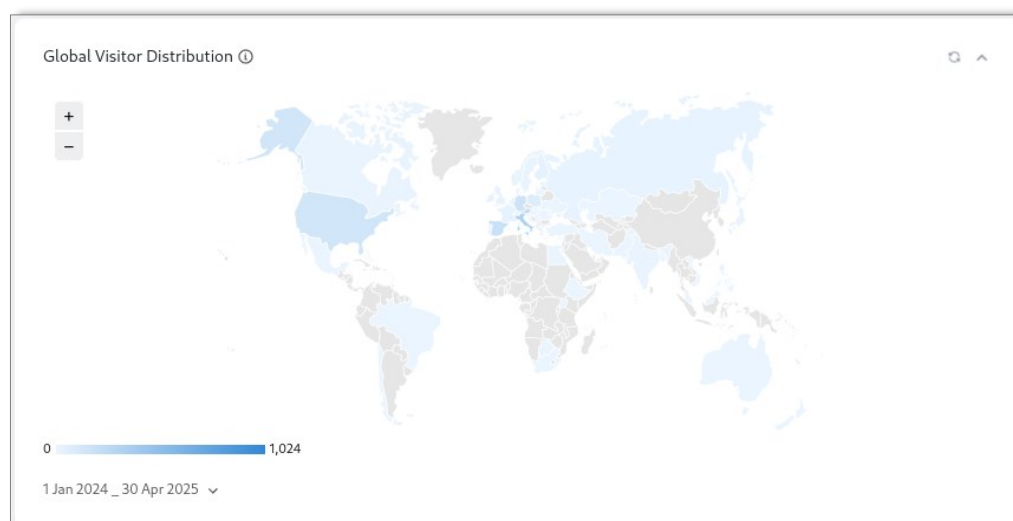


Figure 10. Visits to the EMERALD website by geographical location

Country	Visitor Count	View Count
 Italy	331	1,860
 Austria	234	738
 Spain	180	466
 Germany	167	389
 United States	144	202
 Poland	74	255
 Netherlands	45	65
 Ireland	35	49
 France	25	104

Figure 11. Countries with the highest number of visits to the EMERALD website

Search Engine Optimization (SEO) performance is continuously improving thanks to the provision of dedicated and targeted content through the fragments and social media. As shown in Figure 12, visits from direct search queries represent about 60.18% of the traffic, while 31.26% of visitors come from organic searches, 3.47% from social networks and 0.11% from videos. Direct searches allow users to access the site directly by typing the URL into the browser bar. Organic searches are made by users who search for the site and reach it through search engines. Finally, some users come to the site through links on social networks and videos.

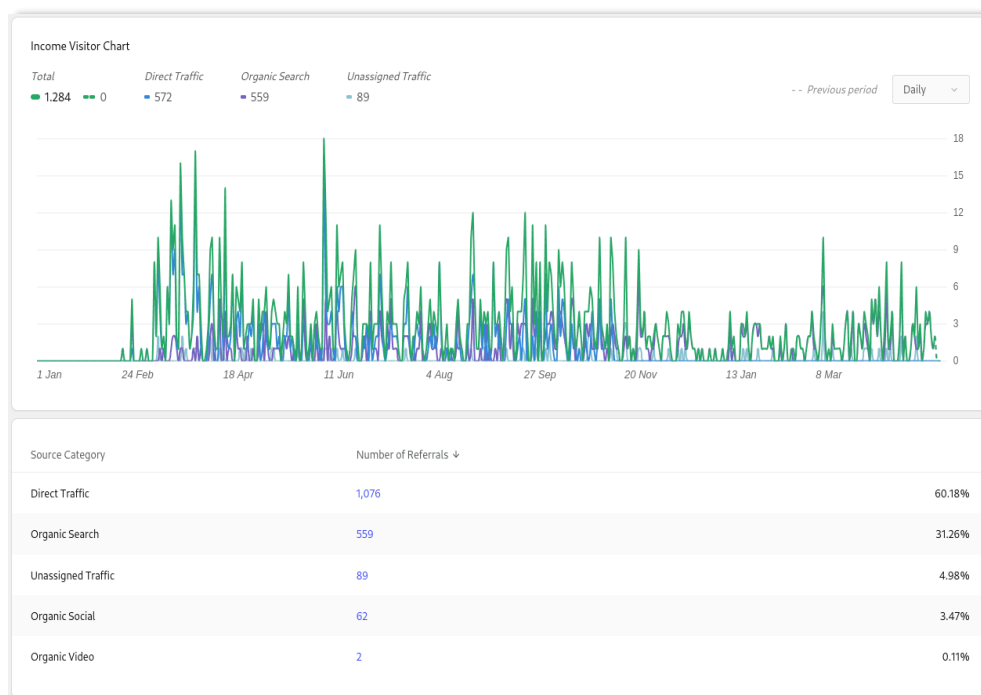


Figure 12. Global traffic on the EMERALD website

In terms of visitors coming from social networks (see Figure 13), LinkedIn has been the main channel used to access EMERALD website, accounting for more than 88.7% of visits, followed by Facebook, LinkedIn and X with 3.23% and Instagram with 1.61%. The limited traffic generated from X reflects its decreasing relevance as a communication channel for the project. This issue is further discussed in Section 4.2.1, where we provide additional context.

Domain Address	Source Name	Number of Referrals ↓
linkedin.com	LinkedIn	55
facebook.com	Facebook	2
lnkd.in	LinkedIn	2
t.co	Twitter	2
instagram.com	Instagram	1

Figure 13. Traffic generated by the social networks

4.2 Social Networks

EMERALD social networks are mostly used to drive traffic to the project website, where more detailed content is available. Regular updates on technical advancements, outcomes, news, and events about EMERALD are published on the project's social channels.

From the range of the existing social networks, EMERALD has mainly focused on X, LinkedIn and YouTube during the first half of the project. In the following sections, we explain how each social network has been used to promote the activities of the EMERALD project.

4.2.1 X

The project's X account **@EmeraldHEproj** was created in November 2023, shortly after the start of the project (see Figure 14). The X feed can be found at the following link: <https://x.com/EmeraldHEproj>.

Until the 28th of April 2025, this account has a total of 34 followers and 55 posts have been posted. The relatively low engagement can be attributed to several factors, including the recent shifts in the political landscape, which have impacted the visibility and traction of initiatives of this nature. Additionally, the general decline in user activity on X—following the departure of many users from the platform—has made it increasingly challenging to reach a broader audience through this channel. As a result, the EMERALD consortium is considering closing the account, a decision further elaborated in Section 7.2, in relation to the project's KPIs.

The posts published include both original content (e.g. attendance at events, blog posts, press releases) and retweets of content from external stakeholders that can be interesting and relevant for the project's audience. Every time a significant event takes place in EMERALD, such as the publication of fragments, deliverables, videos, posters or press releases, a tweet is posted, including detailed information, the URL to the content, and relevant hashtags. The aim of including links to other resources is to generate interest in additional content and thus increase awareness of the EMERALD project. In addition, EMERALD partners use their respective X feeds to directly promote EMERALD-related events and news. Therefore, the X profile of EMERALD functions as a central hub that retweets partners' mentions and ensures a centralized distribution of all project-related news.

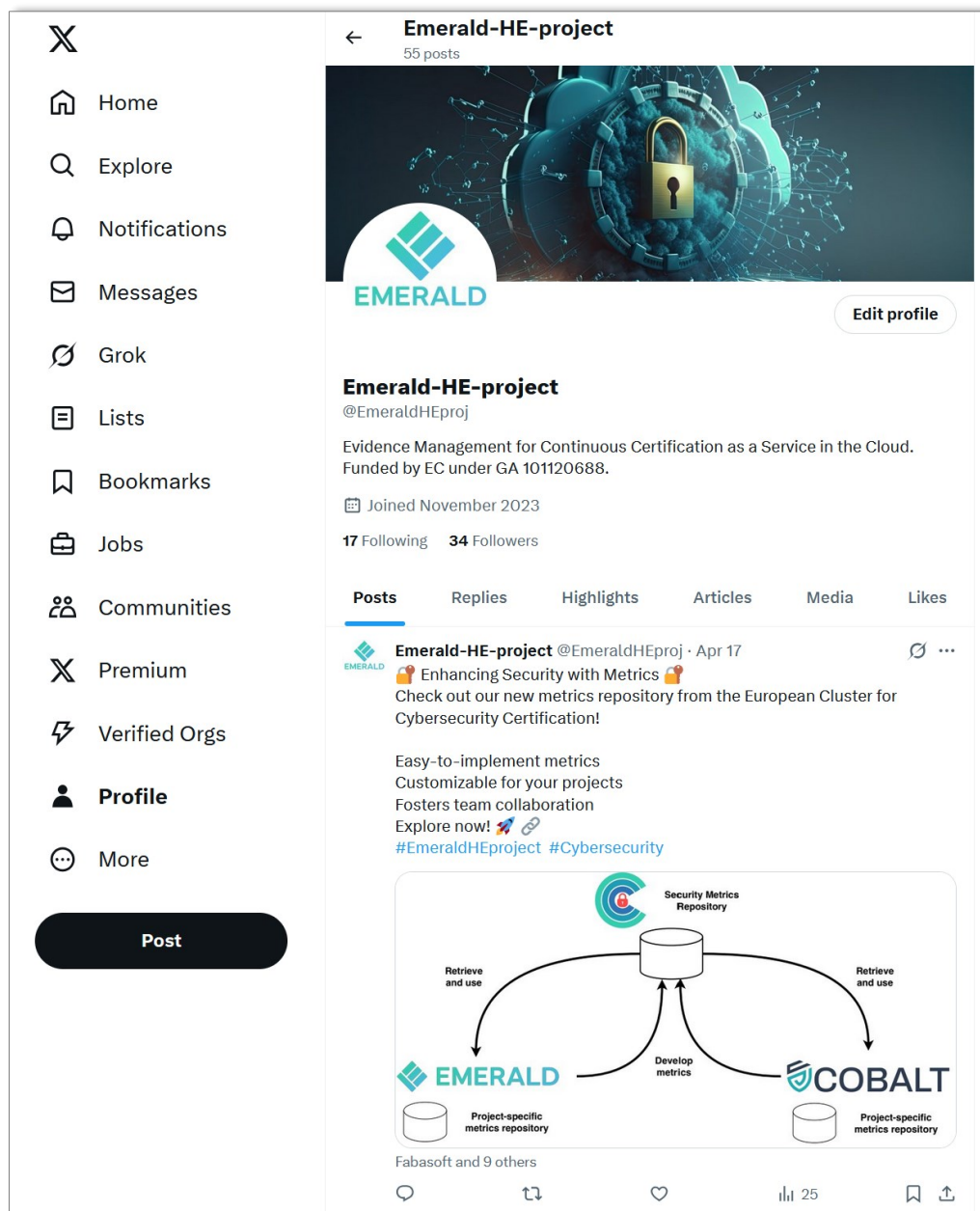


Figure 14. Homepage of the X account of EMERALD

4.2.2 LinkedIn

LinkedIn is a social network that helps expand connections and foster interpersonal relationships between EMERALD partners and other professionals involved in cybersecurity, cloud computing and certification. LinkedIn is the most prominent of the EMERALD project's social networks. EMERALD fragments published monthly on the website are linked in the posts published on the EMERALD LinkedIn page to attract more visitors to the website. Up to April 2025, the EMERALD LinkedIn page (shown in Figure 15) has 94 followers, and 48 posts published in the last year. The total number of impressions during the last 365 days is 18,849 and the number of reactions is 624 (see Figure 16). EMERALD LinkedIn page can be found at the following link: <https://www.linkedin.com/company/emerald-he-project/>.

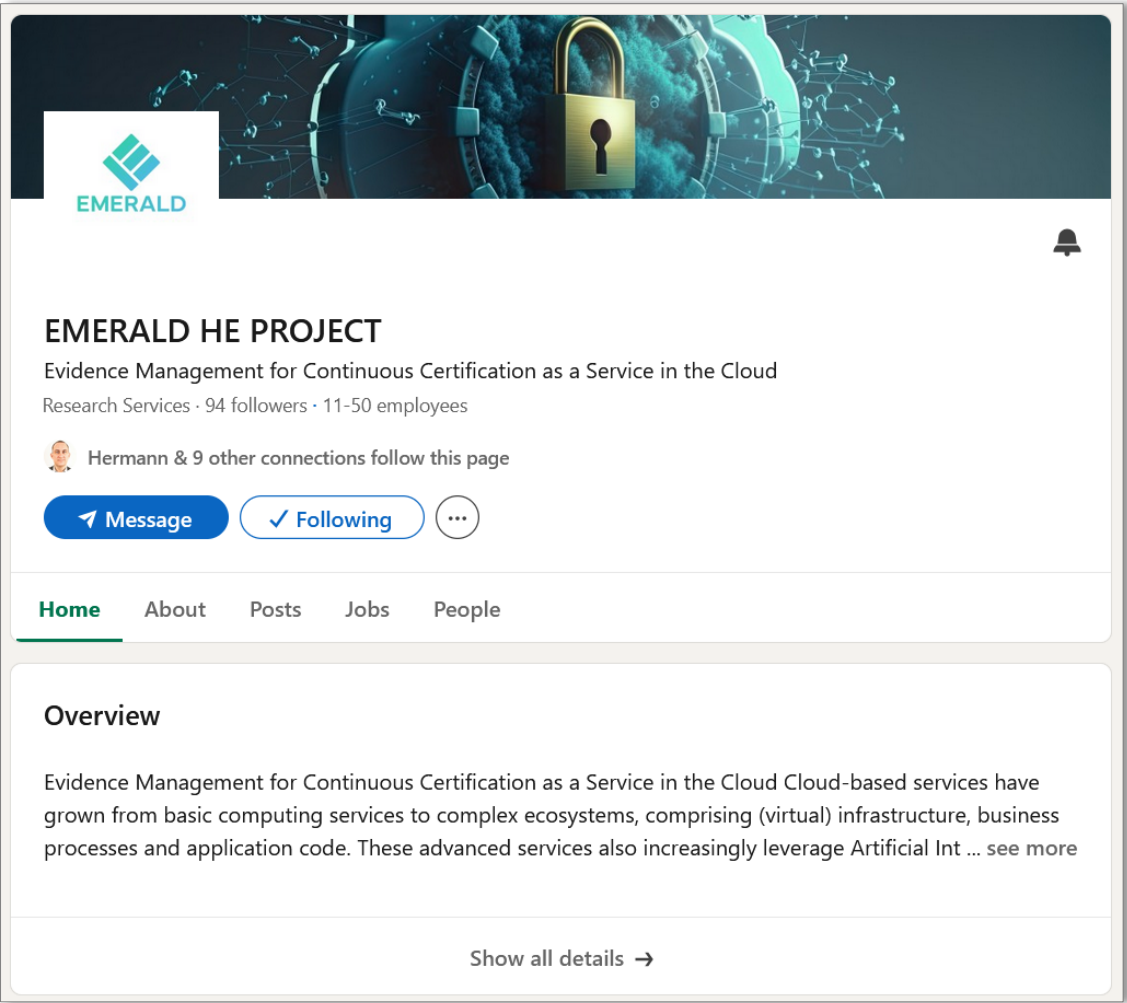


Figure 15. Homepage of the LinkedIn page of EMERALD

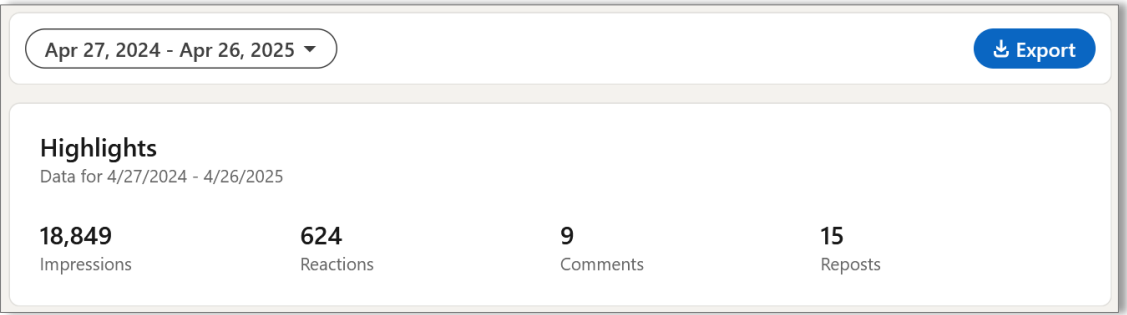


Figure 16. Analytics for the LinkedIn page of EMERALD over the past 365 days

4.2.3 YouTube

The YouTube channel serves as a repository for all video content related to the project. It is designed to showcase the practical applications and functionalities of EMERALD through detailed video demonstrations. The aim is to engage viewers by showing the tangible benefits of the project, thereby increasing understanding and support among the target audience.

After the first eighteen months, the EMERALD YouTube channel hosts two videos (see Figure 17). The first video, produced by TECNALIA, provides an overview of the EMERALD project and its approach to Evidence Management for Continuous Certification as a Service in the Cloud. The

second one, created by SCCH, demonstrates how EMERALD simplifies the certification process for cloud services. To maximize visibility and outreach, each uploaded video has been promoted across various social media platforms, accompanied by brief descriptions and direct links to detailed content.

The YouTube channel is expected to expand over time, incorporating additional content as the project progresses and further milestones are achieved. The EMERALD's YouTube channel can be found at the following link: <https://www.youtube.com/@emerald-he-project>.

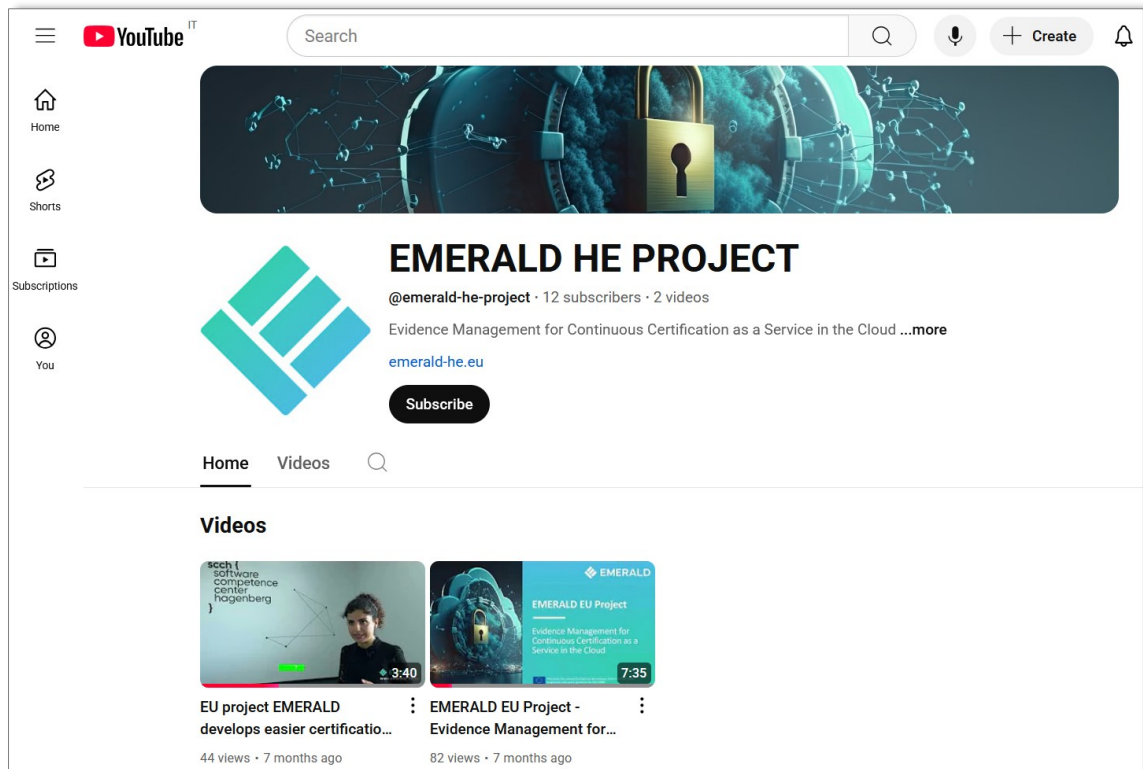


Figure 17. Homepage of the YouTube channel of EMERALD

4.3 Flyers

An EMERALD flyer, the first in a series of three, has been realized with the aim of raising awareness of the EMERALD project and presenting the key project information in a straightforward manner. It also aims to highlight the project's innovative approach to evidence management for Continuous Certification in Cloud Services and to entice the reader to visit EMERALD's website for further insights.

The EMERALD flyer features a tri-fold layout, carefully designed to combine aesthetic appeal with text clarity. Each of its six panels serves a distinct purpose, guiding the reader through a comprehensive overview of the project (see Figure 18). The layout maintains a balanced integration of textual content and visual elements, ensuring a cohesive appearance while making the information accessible and easy to understand. For a more detailed description of the flyer's content and design rationale, please refer to deliverable D6.1 [5].



Figure 18. First EMERALD flyer

This flyer presents key details about the project's objectives, benefits, partners, and contact information, along with links to its social media channels. It has been specifically designed for easy printing by each partner and for distribution at relevant events and conferences to present EMERALD. It can be viewed and downloaded inside the subsection “Communication” of the project website at the following link: <https://www.emerald-he.eu/flyers/> and it is also included in APPENDIX A for completeness.

Additional flyers are planned to ensure alignment with the KPI target. The second flyer, scheduled for publication by the end of July 2025, will focus on the integrated version of the EMERALD framework, recently released, and will provide insights into its architecture and functionalities. A third and final flyer is planned towards the end of the project, offering a summary of the main results and impacts achieved. This plan demonstrates the consortium’s commitment to structured and timely communication throughout the project lifecycle.

4.4 Press releases

The EMERALD press releases intend to identify the project milestones emphasizing a clear and to-the-point presentation of goals, key achievements, approaches adopted, benefits, events and partner initiatives, being essential for maintaining visibility and engaging with a broader audience. They are drafted to be addressed to the scientific and technical community, technology providers, certification agencies, cloud services providers and consumers, auditors, security certification experts and the public. They are also means of dissemination for media and press agencies so that they can learn about the work being developed in the EMERALD project.

The first joint consortium press release has been produced in the English language²⁶ and has also been translated into all the languages of the partners involved in the project, namely Finnish, German, Italian, Polish, and Spanish. It has been disseminated through the project's social networks and all versions are available and can be downloaded from the project website, inside the sub-section "Communication", at the following link <https://www.emerald-he.eu/press-release/> (see Figure 19). Figure 20 shows the English version of the first EMERALD press release. The versions in other languages can be found in *APPENDIX B* and online in the project website.

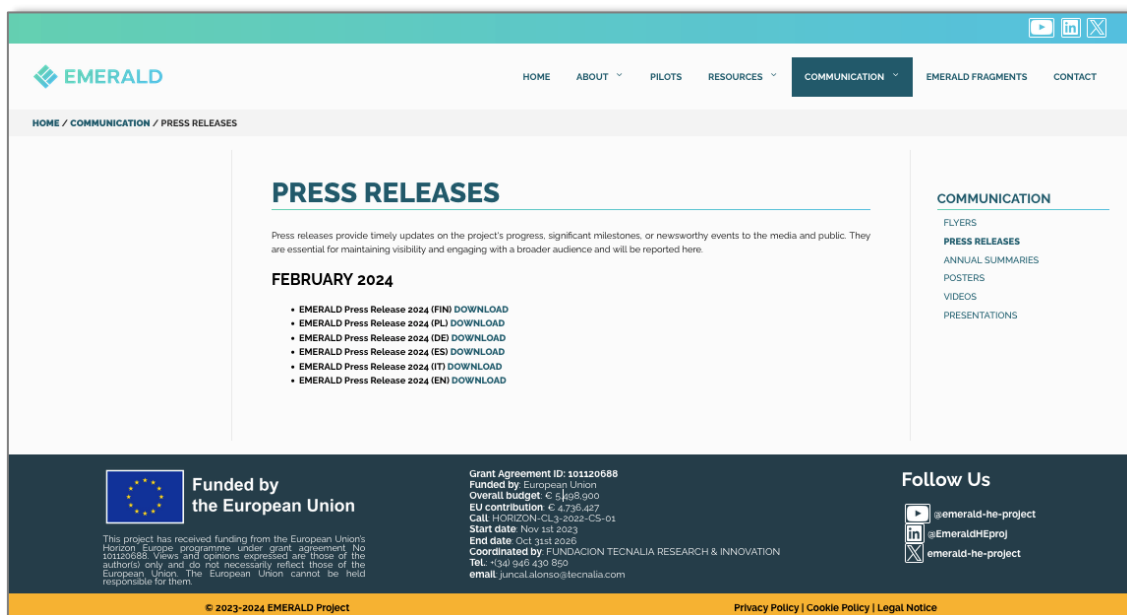


Figure 19. Webpage dedicated to press releases on the EMERALD website

Partners have also been encouraged to produce their own press releases for distribution to national media and local communication. CaixaBank and SCCH have published their own press releases enhancing their specific roles within the project (see *APPENDIX C*).

²⁶https://www.emerald-he.eu/wp-content/uploads/2024/02/EMERALD_Press_release_Feb2024ENG.pdf



Figure 20. First EMERALD press release in English

4.5 Other Communication Activities

Table 2 lists other communication activities and press articles undertaken by individual partners during the early stages of the project.

Table 2. Other communication activities at M18

Type	Link	Partner
Press article/News	https://www.tecnalia.com/noticias/emerald-innovacion-en-seguridad-y-eficiencia-para-servicios-en-la-nube	TECNALIA
LinkedIn	https://www.linkedin.com/posts/tecnalia-research-innovation_innovamos-en-seguridad-y-fomentamos-la-eficiencia-activity-7190613059885780994-laNh?utm_source=share&utm_medium=member_desktop&rcm=ACoA AAgNDt4BzEZ4vKN94C-BomXI8xYIUEVUPnc	TECNALIA
LinkedIn	https://www.linkedin.com/posts/tecnalia-research-innovation_emerald-eu-project-evidence-management-activity-7249301603353063424-YGlf?utm_source=share&utm_medium=member_desktop&rcm=ACoA AAgNDt4BzEZ4vKN94C-BomXI8xYIUEVUPnc	TECNALIA
Press article/News	https://www.caixabank.com/es/actualidad/noticias/caixabank-participa-en-un-consorcio-europeo-para-definir-un-marco-de-evaluacion-y-certificacion-de-servicios-en-la-nube	CXB
Press article/News	https://www.computing.es/cloud/caixabank-participa-en-emerald-proyecto-europeo-para-la-seguridad-de-los-servicios-cloud/	CXB

Type	Link	Partner
Press article	https://www.digitalbusiness-magazin.de/compliance-im-finanzen-sektor-fabasoft-unterstuetzt-eu-projekt-a-32c8017a571e3e7d82557a8dbb393bc9/?cmp=beleg-mail&pt=67c806db88a08	FABA
Press article	https://www.digital-manufacturing-magazin.de/compliance-im-finanzen-sektor-fabasoft-unterstuetzt-eu-projekt-a-32c8017a571e3e7d82557a8dbb393bc9/	FABA
Press article	https://www.iavcworld.de/digitalisierung/10709-automatisierte-compliance-fabasoft-unterstuetzt-eu-forschungsprojekt.html	FABA
Press article	https://ap-verlag.de/continuous-compliance-automatisierte-compliance-fuer-den-finanzen-sektor/94482/	FABA
Press article	https://www.datacenter-insider.de/automatisiertes-compliance-management-fuer-banken-clouds-a-f54c8f9bc8c540edffb23348efc3b5c8/?cmp=beleg-mail&pt=67da6b787a269	FABA
Press article/News	https://www.cnr.it/it/news/12542/emerald-trasforma-il-panorama-dei-servizi-basati-sul-cloud-sviluppando-un-nuovo-framework	CNR

5 Dissemination Activities

This section reports the results of the dissemination activities conducted during the first eighteen months of the EMERALD project. The revision of the dissemination KPIs can be found in Section 7.1.

Dissemination activities mainly include scientific publications, participation to industrial events related to EMERALD's topics, as well as participation to conferences, panels, lectures, seminars and similar venues, in which the EMERALD project has been presented.

The dissemination activities are supported by a set of dedicated materials specifically created for the EMERALD project. These include brochures, flyers, posters, showcases, and presentations, all designed to effectively disseminate the project's objectives, findings, and impact to various stakeholders.

5.1 Publications

This section presents the scientific publications (up to month eighteen included) developed within the EMERALD project, which have been either published or accepted for publication. A total of **five publications** have been produced: **one journal paper** and **four conference contributions**. The publications and their details are listed in Table 3.

Table 3. List of scientific publications.

Status	Title of the article	Authors and Organisations	Title of the journal or proceedings	Volume, number, pages	Publisher	Year	Identifier (if available)	Open access provided?
Published	Owl2proto: Enabling Semantic Processing in Modern Cloud Micro-Services	Christian Banse (FHG), Angelika Schneider (FHG), Immanuel Kunz (FHG)	Proceedings of the 16 th International Conference on Knowledge Engineering and Ontology Development (KEOD 2024)	pp. 199-206	SCITEPRESS Digital Library	2024	https://doi.org/10.5220/0012993600003838	Yes
Published	CertGraph: Towards a Comprehensive Knowledge Graph for Cloud Security Certifications	Stefan Schöberl (SCCH), Christian Banse (FHG), Verena Geist (SCCH), Immanuel Kunz (FHG), Martin Pinzger	Proceedings of the ACM/IEEE 27th International Conference on Model Driven Engineering Languages and Systems (MODELS Companion 2024)	pp. 76-77	ACM Digital Library	2024	https://doi.org/10.1145/3652620.3687795	No
Accepted, in press	Automatic association of quality requirements and quantifiable metrics for cloud security certification	John Bianchi, Shuya Dong, Luca Petrillo and Marinella Petrocchi (CNR)	Proceedings of the 4th Italian Workshop on Artificial Intelligence and Applications for Business and Industries (AIABI 2024)	In press	Springer Verlag LNAI	2024	https://doi.org/10.48550/arXiv.2503.09460 (arXiv)	Yes, in press
Accepted, in press	EMERALD: Evidence Management for Continuous Certification as a Service in the Cloud	Christian Banse (FHG), Björn Fanta (FABA), Juncal Alonso (TECNALIA), Cristina Martinez (TECNALIA)	Proceedings of the 15th International Conference on Cloud Computing and Services Science (CLOSER 2025)	In press	SCITEPRESS Digital Library	2025	https://doi.org/10.48550/arXiv.2502.07330 (arXiv)	Yes, in press
Published	Blockchain-Based Evidence Trustworthiness System in Certification	Cristina Regueiro (TECNALIA) and Borja Urquizu (TECNALIA)	Journal of Cybersecurity and Privacy	vol. 5, n. 1	MDPI	2025	https://doi.org/10.48550/arXiv.2502.07330	Yes

5.2 EMERALD News

EMERALD News consists of annual summaries that provide an accessible and comprehensive overview of the project's progress, achievements, and key findings. These summaries are designed to engage a broad audience, including stakeholders, funding bodies, and the public, by highlighting milestones and future directions. They are distributed through the project's website, emails, and social media channels to ensure widespread dissemination.

The first EMERALD summary, written in month 12, covers the progress and results achieved during the first year of the project. This brochure serves as a key resource to communicate the consortium's advancements and impact, and it was used as an introductory presentation document at the External Advisory Board kick-off meeting (see Section 6.4).

The EMERALD annual summary is designed as an A5 booklet in landscape orientation. It is functional for reading on a device or for printing. The entire booklet consists of 24 pages. Apart from the cover, the first two pages are dedicated to the table of contents and the introduction to the project. Page 5 features a photo of all the partners taken during the General Assembly in October 2024, held in Barcelona. After that, there are two pages dedicated to the overall structure of the project and each of the seven work packages (WPs).

The penultimate page of the booklet briefly illustrates what's next for the project. At the end, we include a map of European countries, highlighting those that are partners of the EMERALD Project, along with the names of all the partners.

In *APPENDIX D* you can find screenshots of all the pages of the booklet, which is also available at <https://www.emerald-he.eu/annual-summaries/>.

The next annual summary will be published after the second year of the project, providing an updated account of progress and outcomes.

5.3 Posters

The objective of the EMERALD posters is to enhance visibility and recognition at various events, conferences, and workshops dedicated to the dissemination of project results.

During the first eighteen months of the project, three posters were created. The first two posters contain general content: the first poster was designed to summarize the results achieved during the first year and was distributed through online channels, and the second poster was used to present the EMERALD project at the *12th Conference of the European Union's Framework Programme for Research and Innovation* in Spain²⁷, titled "Beyond Horizon" (see Section 5.5), whose main aim was to evaluate the initial years of Horizon Europe and its key initiatives. These posters are available for access on the project website²⁸. In addition, these two posters have been included in *APPENDIX E* for completeness.

The third poster, created by the partner SCCH, was used to support the presentation of the work "CertGraph: Towards a Comprehensive Knowledge Graph" at the *27th International Conference on Model-Driven Engineering Languages and Systems*²⁹ (see Figure 21). This event is also listed in Section 5.5, which provides an overview of the key conferences and dissemination opportunities attended by the consortium.

²⁷ <https://12conferenciapm.cdti.es/en>

²⁸ <https://www.emerald-he.eu/posters/>

²⁹ <https://conf.researchr.org/home/models-2024>

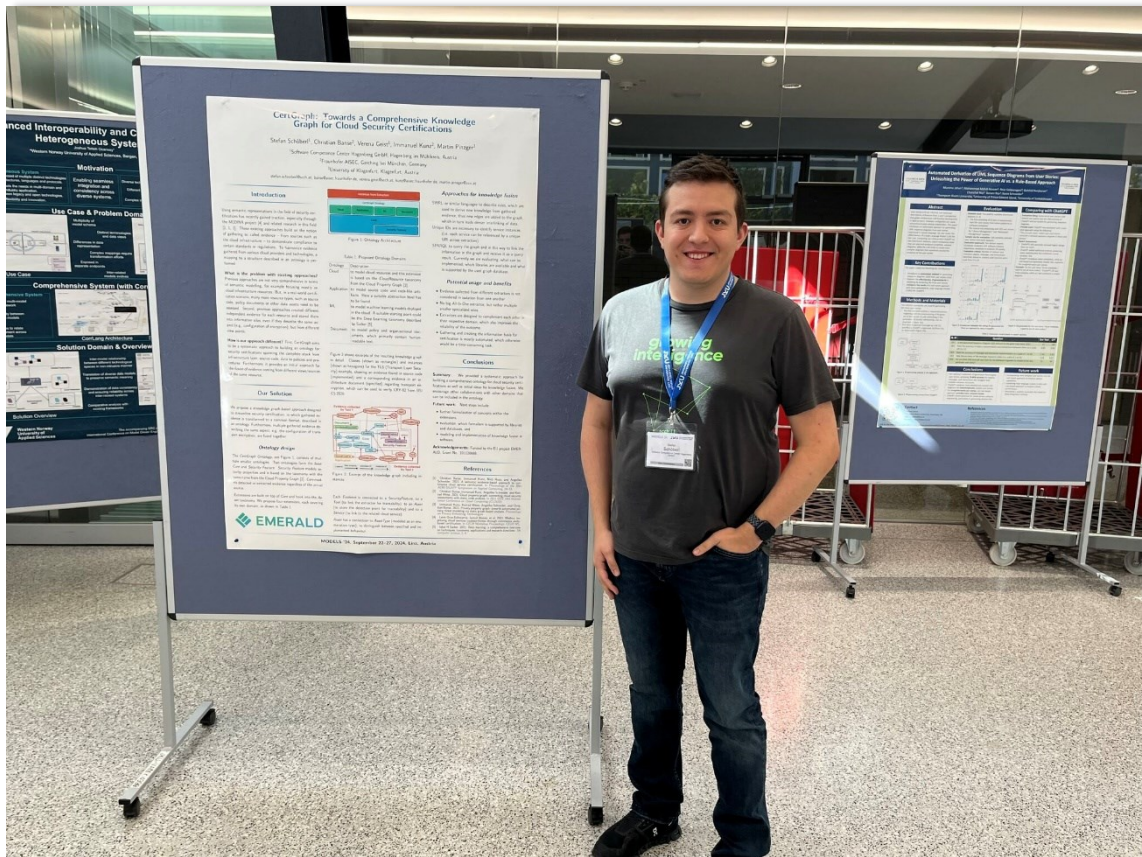


Figure 21. Stefan Schöberl from SCCH presenting CertGraph at MODELS 2024 conference

5.4 Project showcases

Videos are a powerful medium for disseminating the work conducted within the EMERALD project. As a result, various types of videos are planned, tailored to different target audiences (see Section 7.2). Additional details about the project's presence on YouTube, including the types of content shared and performance metrics, can be found in Section 4.2.3.

In the first eighteen months of the project, two videos have been created:

- An introductory video presenting the project's objectives and key benefits, released by TECNALIA.
- A specialized video highlighting the role of SCCH in the EMERALD project, created by the correspondent partner.

All showcases and videos are available both on the EMERALD website³⁰ and on the EMERALD YouTube channel³¹.

5.5 Events

Participation in events is an effective way to increase the visibility of the EMERALD project, to foster collaboration with other initiatives, and to stay informed about the latest developments in relevant research and industrial areas. Events provide valuable opportunities to share

³⁰ <https://www.emerald-he.eu/videos/>

³¹ <https://www.youtube.com/@emerald-he-project>

knowledge, receive feedback and engage with key stakeholders. In this context, we distinguish between **active participation** and **simple attendance**. In the former, the EMERALD project, or specific aspects of it, are presented and/or discussed, contributing directly to the event's program. In the latter, partners attend events whose topics are related to the project but without actively presenting EMERALD. Both types of participation are important for networking and knowledge acquisition throughout the project lifecycle.

The events in which EMERALD was actively presented, along with their details, are listed in Table 4. These include 5 talks, 1 booth, 1 seminar, 4 paper presentations, 2 poster presentations, 2 webinars, and 1 keynote speech. Events attended by project partners without direct presentations of EMERALD (or parts of it) are reported in Table 5 and include 1 seminar, 1 talk, and 1 meeting.

Table 4. List of events in which the EMERALD project (or parts of it) has been actively presented

Event	Date	Name and type of audience	Countries addressed	Size of audience	EMERALD People attending (names)
Talk: “The EMERALD project” at IITDay2023, Pisa, Italy	Dec 18, 2023	Scientific community and public	Italy	120	Marinella Petrocchi (CNR), Michela Fazzolari (CNR), Adriana Lazzaroni (CNR), Patrizia Andronico (CNR), Raffaella Casarosa (CNR)
Talk: “Leveraging Open-Source for Security Certifications” at the workshop on Open-Source key areas for Digital Autonomy, Brussels, Belgium https://digital-strategy.ec.europa.eu/en/events/workshop-open-source-key-areas-digital-autonomy	Feb 1, 2024	Industry	Europe	60+	Christian Banse (FHG)
Talk: “Software-Driven Implementation of the EUCS” at Bitkom AK Cloud Services & Digital Ecosystems Workgroup meeting, Frankfurt, Germany https://www.emerald-he.eu/emerald-at-bitkoms-expert-group-on-cloud-services-digital-ecosystems/	Mar 20, 2024	Cloud Service Providers, Auditors, German BSI	Europe	30	Björn Fanta (FABA)
Booth presenting EMERALD at Hannover Messe 2024, Hannover, Germany	Apr 22-26, 2024	Industry, Cloud Service Providers, Security Experts	Europe	200K	Netsanet Haile Gebreyesus (IONOS)
Seminar: “Beyond Digital Savvy: Illuminating the Path from Digital Proficiency to AI Literacy” at NTNU (Norwegian University of Science and Technology), Trondheim, Norway https://www.ntnu.edu/excited/open-webinars-2024	May 23, 2024	Researchers and Students from NTNU, Department of Computer Science	Norway, Austria	20-25	Angela Fessler (KNOW)
Paper/poster presentation: “CertGraph: Towards a Comprehensive Knowledge Graph for Cloud Security Certifications” at MODELS 2024, Linz, Austria	Sep 22-27, 2024	Academia	International	300+	Stefan Schöberl (SCCH)
Talk: “Introduction to the MARI tool” at SERICS (SEcurity and Rights In the Cyberspace) Spoke 1 meeting 2024, Pisa, Italy	Oct 10, 2024	Academia, Industry	Italy	25	Marinella Petrocchi (CNR), Michela Fazzolari (CNR)

Event	Date	Name and type of audience	Countries addressed	Size of audience	EMERALD People attending (names)
Talk: “CERTGRAPH: Applying Knowledge Graphs for Cloud Certification” at ETSI Security Conference 2024, Sophia Antipolis, France https://www.etsi.org/events/2445-etsi-security-conference-2024#pane-5/	Oct 14-17, 2024	Academia	Europe	100+	Stefan Schöberl (SCCH)
Webinar: “Cloud / Edge Security Challenges” In collaboration with ECCO (European Cyber Security COmmunity Project), online https://cybersecurity-centre.europa.eu/events/cloud-edge-security-challenges-12-november-2024-webinar-2024-11-12_en	Nov 12, 2024	Industry	Europe	50	Juncal Alonso, Cristina Martinez, Iñaki Etxaniz (TECNALIA), Christian Banse (FHG), Jordi Guijarro (ONS)
Paper presentation: “owl2proto: Enabling Semantic Processing in Modern Cloud Micro-Services” at KEOD 2024, Porto, Portugal	Nov 17-19, 2024	Academia, Industry	International	150+	Christian Banse (FHG)
Poster presentation: “The EMERALD project” at the 12 th Conference on the European Union's Framework Programme for Research and Innovation in Spain -Horizon Europe", Oviedo, Spain https://12conferenciapm.cdti.es/en https://12conferenciapm.cdti.es/blog/38	Nov 28, 2024	Entities interested in participating in EU projects	Spain	150+	Juncal Alonso (TECNALIA)
Paper presentation: “Automatic association of quality requirements and quantifiable metrics for cloud security certification” at 4th Italian Workshop on Artificial Intelligence and Applications for Business and Industries - AIABI 2024, Bozen, Italy https://www.aiabi2024.com/	Nov 25-28, 2024	Academia	Europe	80	John Bianchi (CNR)
Keynote speech (in Spanish): “R&D&I in Cybersecurity in the EU” at the Plenary Meeting of the Spanish Security Users Community (CoU Spain) + Thematic Groups, organized by the Centre for the Development of Industrial Technology (CDTI), under the Ministry of Science, Innovation and Universities, Madrid, Spain	Feb 18, 2025	Academia, Industry, Government agencies	Spain	20	Ana Ayerbe (TECNALIA)
Paper presentation: “EMERALD: Evidence Management for Continuous Certification as a Service in the Cloud” Panel: “Cybersecurity certification for the Computing Continuum: Future Challenges and Opportunities”, both at CLOSER 2025, Porto, Portugal	Apr 1-3, 2025	Academia, Industry	International	15	Christian Banse (FHG)

Event	Date	Name and type of audience	Countries addressed	Size of audience	EMERALD People attending (names)
Webinar&Roundtable: “Latest research results in IoT Supply Chain security to ensure compliance with the CRA” at Global IoT Day, online https://iotday.org/events/2025/iot-day-2025-webinar-roundtable-latest-research-results-in-iot-supply-chain-security-to-ensure-compliance-with-the-cra/	Apr 9, 2025	Industry	International	71	Björn Fanta (FABA), Christian Banse (FHG)

Table 5. List of the events attended by partners, whose topics are EMERALD-related.

Event	Date	Name and type of audience	Countries addressed	Size of audience	EMERALD People attending (names)
Seminar: “States, Societies and Security in the 21st Century”, West Point, USA https://csds.vub.be/event/states-societies-and-security-in-the-21st-century/	Feb 7-8, 2024	Academia, Industry	International	40	Daisy Romanini (CNR)
12 th meeting of the Stakeholder Cybersecurity Certification Group, online https://digital-strategy.ec.europa.eu/en/policies/stakeholder-cybersecurity-certification-group	Mar 3, 2024	SCCG members, ENISA, EC	Europe	100	Juncal Alonso (TECNALIA)
Talk: “How do we reduce the European Cyber Skills Gap?” at Barcelona Cybersecurity Congress 2024, Barcelona, Spain https://cybersecurity-centre.europa.eu/events/barcelona-cybersecurity-congress-21-23-may-2024-barcelona-spain-2024-05-21_en	May 21-23, 2024	Academia, Industry	Europe	30	Ramon Martín de Pozuelo (CXB)

5.6 Presentations

Presentations play a crucial role in the EMERALD project by facilitating the dissemination of its objectives, progress, and results to a wide range of stakeholders. They serve as an effective means to communicate the project's impact, foster collaborations, and engage with the broader scientific and industrial communities.

During the first eighteen months of the project, a general presentation was created to provide a structured and consistent introduction to the EMERALD project. This presentation includes an overview of the project, background, objectives, focus, goal, partners and contact information, and was designed for use by all partners when showcasing the project's progress at events and meetings. To ensure its relevance and accuracy, it will be continuously updated throughout the lifecycle of the project.

This presentation, whose header is shown in Figure 22, is also available online in the EMERALD website³², moreover the full content is reported in *APPENDIX F*.

³² https://www.emerald-he.eu/wp-content/uploads/2024/04/EMERALD_Presentation_v1.0.pdf



Figure 22. First slide of the EMERALD General Presentation

5.7 Cloud Community Publications

The EMERALD project has gained significant recognition in the broader community through various external references. These references, including mentions on project websites, publications, and collaboration to joint actions, help to highlight the project's relevance and impact within the field. Monitoring these citations is essential to measure the visibility and influence of the project.

The project website has been referenced on the following pages.

IoT Day 2025

EMERALD participated in the Global IoT Day Live Webinar and Roundtable on April 9, 2025, focusing on the latest research results in IoT supply chain security to ensure compliance with the Cyber Resilience Act. The project contributed to discussions on Certification as a Service, emphasizing its role in advancing continuous certification methodologies (<https://dossproject.eu/iot-day-webinar-2025/>).

12th Conference on Project Management by CDTI

EMERALD was mentioned in the context of the 12th Conference on Project Management organized by CDTI, underscoring its contributions to project management practices in cybersecurity certification (<https://12conferenciapm.cdti.es/blog/38>).

European Cluster for Cybersecurity Certification

EMERALD is a contributing project to the European Cluster for Cybersecurity Certification, which aims to foster collaboration among research initiatives addressing challenges in next-generation agile certification. This involvement highlights EMERALD's commitment to developing interoperable cybersecurity requirements and methodologies (<https://cybersecuritycertcluster.eu/>).

Cyberwatching.eu Project Hub

EMERALD is featured on Cyberwatching.eu, a platform that showcases EU-funded cybersecurity projects. The listing provides an overview of EMERALD's objectives and its role in enhancing continuous certification as a service in the cloud (<https://www.cyberwatching.eu/projects/3738/emerald>).

CORDIS - EU Research Results

The CORDIS platform includes a detailed fact sheet on EMERALD, outlining its objectives, funding details, and expected outcomes. This listing enhances the project's visibility within the European research community (<https://cordis.europa.eu/project/id/101120688>).

Article on DORA Compliance

An article (in German language) by FCH Gruppe discusses implementing outsourcing management in compliance with the Digital Operational Resilience Act (DORA). It mentions EMERALD as an initiative aimed at enhancing evidence management for continuous certification in cloud services, aligning with DORA's requirements (<https://fch-gruppe.de/Beitrag/22731/auslagerungsmanagement--dora-konform--digital-implementieren-?id=22731>).

DOSS Project Website

EMERALD is featured on the DOSS project website in relation to the Global IoT Day 2025 Webinar and Roundtable. This highlights the collaboration between European projects working on IoT supply chain security and showcases EMERALD's contribution to advancing continuous certification approaches. The DOSS project focuses on secure-by-design methodologies and integrated validation frameworks for IoT operations, providing a complementary perspective to EMERALD's objectives (<https://dossproject.eu/iot-day-webinar-2025/>).

Additionally, the EMERALD project has been mentioned on various international and national websites, further highlighting its impact and relevance within the field of cloud security and certification (see Table 6). These mentions contribute to the growing visibility of the project, reinforcing its importance in advancing cybersecurity standards and fostering collaboration across Europe.

Table 6. References to the EMERALD project in national and international websites

Context	Reference Link
EMERALD description on the website of CLOSER International Conference 2025	https://www.insticc.org/node/TechnicalProgram/closer/2025/presentationDetails/133481
EMERALD paper in The Moonlight website	https://www.themoonlight.io/de/review/emerald-evidence-management-for-continuous-certification-as-a-service-in-the-cloud
CaixaBank's Participation in the EMERALD Project on Computing.es Online Magazine	https://www.computing.es/cloud/caixabank-participa-en-emerald-proyecto-europeo-para-la-seguridad-de-los-servicios-cloud/
EMERALD project listed on OpenAIRE project database	https://explore.openaire.eu/search/project?projectId=corda_he::f1d17947bdba08b20e8afea3b0ca1e1d
CaixaBank's participation in EMERALD project, highlighted on CaixaBank's official news website	https://www.caixabank.com/en/headlines/news/caixabank-is-taking-part-in-a-european-consortium-to-define-a-framework-for-assessing-and-certifying-cloud-services

Context	Reference Link
CaixaBank's involvement in the EMERALD project, mentioned on DataCenterMarket, a Spanish website focused on cloud industry news	https://www.datacentermarket.es/news/caixabank-participa-en-la-definicion-de-un-marco-de-evaluacion-y-certificacion-de-servicios-en-la-nube/
CaixaBank's participation in the EMERALD project, highlighted on La Vanguardia, a major Spanish newspaper covering economy and business news	https://www.lavanguardia.com/economia/20231229/9482415/caixabank-participa-consorcio-europeo-definir-marco-evaluacion-certificacion-nube-agenciaslv20231229.html
CaixaBank's involvement in the EMERALD project, mentioned on Catalunya Press, a Catalan news outlet covering regional and economic topics	https://www.catalunyapress.es/articulo/economia/2023-12-29/4665006-caixabank-colabora-definicion-marco-evaluacion-certificacion-servicios-nube
CaixaBank's participation in the EMERALD project covered by the Spanish news agency	https://www.servimedia.es/noticias/caixabank-participa-consorcio-europeo-para-definir-marco-evaluacion-certificacion-nube/4192870
Italian research institute listing EMERALD among its international projects	https://www.iit.cnr.it/en/projects/international/
Peer-reviewed academic publication mentioning EMERALD in a research article on cybersecurity and certification	https://www.mdpi.com/2624-800X/5/1/1
AcademicLabs: research collaboration platform referencing EMERALD in its database of projects and organizations	https://app.academiclabs.com/organisation/cGb3MSLyEdc
Official Italian government portal listing a research fellowship related to EMERALD	https://bandi.mur.gov.it/bandi.php/public/fellowship/id_fellow/260941
SCCH Austrian research center announcing its participation in the EMERALD project	https://www.scch.at/aktuelles/news/detail/eu-projekt-emerald-gestartet
EMERALD project listed in OpenSecurityData.eu, open-access database for security-related research	https://opensecuritydata.eu/projects/EMERALD-Evidence-Management-for-Continuous-Certification-as-a-Service-in-the-Cloud?p=1&limit=25
Biz-Up: Austrian business and innovation agency mentioning EMERALD in the context of continuous cloud certification	https://www.biz-up.at/artikel/software-zertifizierung-rund-um-die-uhr

6 Networking Activities

Establishing connections and fostering collaboration with other projects and initiatives is a fundamental aspect of a research project like EMERALD.

This section presents the networking and collaboration activities undertaken with other European projects, along with additional initiatives that have the potential to foster cooperation with EMERALD. A dedicated subsection highlights the European Cluster for Cybersecurity Certification (EC3)³³, while the final part outlines the engagements and contributions of the External Advisory Board.

6.1 European Cluster for Cybersecurity Certification

The EC3 aims to serve as a platform for discussion and collaboration among research and innovation initiatives focused on the challenges associated with Next-Generation Agile Certification. By integrating diverse perspectives and methodologies, the cluster seeks to enhance cooperation among ongoing research efforts, facilitating the exchange of experiences and the development of common approaches. Its primary objective is to consolidate a critical mass of projects, enabling the formulation of a comprehensive EU-wide perspective and fostering discussions on adoption challenges and future research directions.

Collaboration will be established through multiple channels, encompassing both technical and dissemination activities.

Technical Collaboration:

- Facilitation of technical exchanges between projects.
- Joint development of scientific publications.
- Sharing and development of best practices for engaging with open-source communities.
- Formulation of research roadmaps to guide future advancements.

Dissemination and Exploitation Collaboration:

- Organization of joint workshops targeting both academic and industrial audiences.
- Support for individual projects through dedicated innovation management events.
- Coordination of joint exploitation workshops, bringing together researchers, technology transfer specialists, legal experts, industry professionals, and venture capital representatives to provide strategic recommendations.
- Development of whitepapers on key thematic areas.

Several initiatives have already been undertaken to advance the EC3. To date, six European projects (namely EMERALD itself, COBALT³⁴, CERTIFAI³⁵, CERTIFY³⁶, DOSS³⁷, and TELEMETRY³⁸) have expressed their interest in joining the cluster, with an additional project (CONFIRMATE³⁹) currently in the final stages of joining. As part of the efforts to establish a dedicated platform for collaboration and knowledge sharing, a website for the Cluster has been developed and is now accessible at <https://cybersecuritycertcluster.eu/> (see Figure 23). Furthermore, the Cluster has

³³ <https://cybersecuritycertcluster.eu/>

³⁴ <https://horizon-cobalt.eu/>

³⁵ <https://certifai.info/>

³⁶ <https://certify-project.eu/>

³⁷ <https://dossproject.eu/>

³⁸ <https://telemetry-project.eu/>

³⁹ <https://www.linkedin.com/company/confirmate-project/>

been officially launched and presented in a dedicated panel at the [CLOSER 2025 conference](#)⁴⁰, (see section 6.1.1) marking a significant step toward fostering engagement within the cybersecurity certification community.

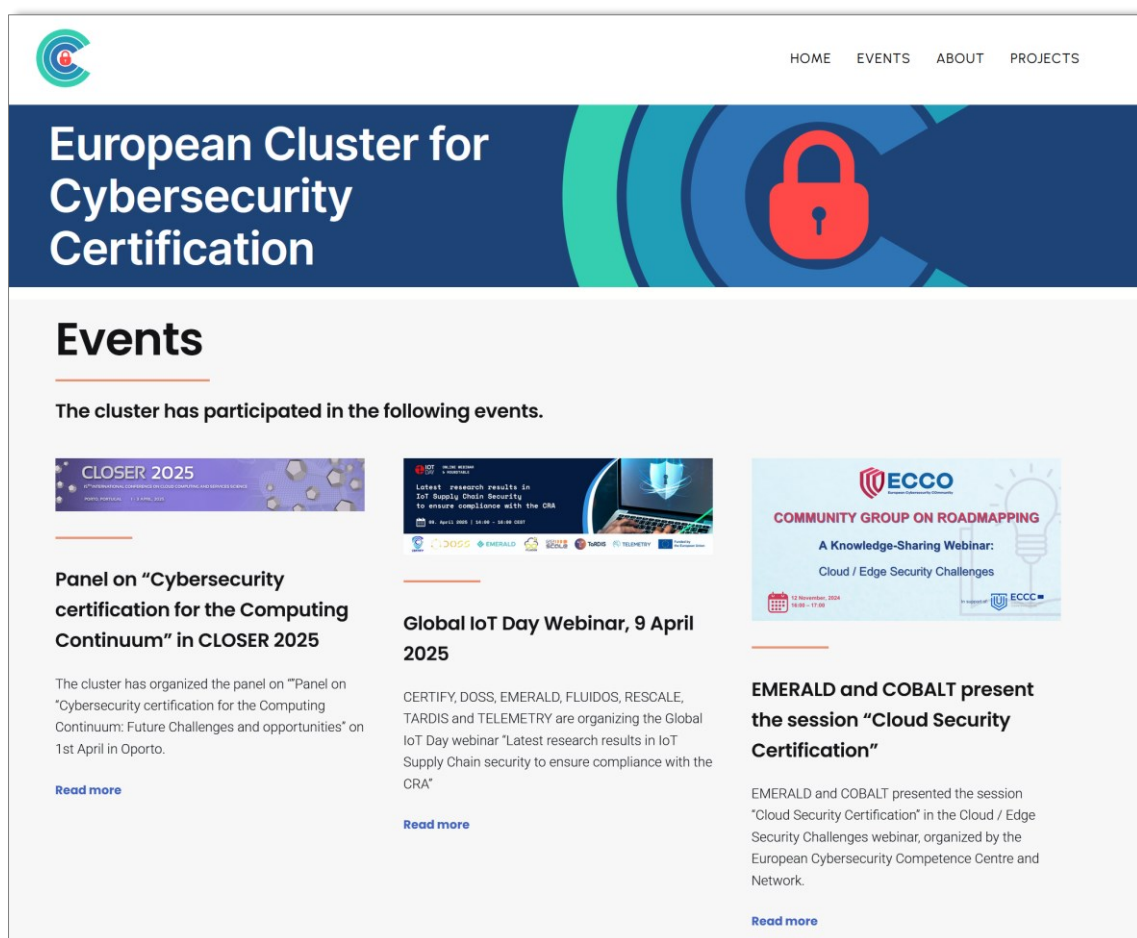


Figure 23. Home page of the European Cluster for Cybersecurity Certification website

An additional ongoing activity within the Cluster is the development of a shared repository⁴¹ of metrics for evidence assessment. This repository has been made publicly available through the EC3 website, under the “Resources” section, to support transparency and promote reuse across related initiatives. In fact, it aims to facilitate a common approach to evaluating security evidence across different certification frameworks, promoting consistency and interoperability in cybersecurity certification processes. EMERALD is contributing to this effort by defining a set of security metrics specifically designed for continuous certification. In particular, EMERALD is focusing on the establishment of a standardized metric data format, which will be defined using a structured ontology, with special focus on cybersecurity metrics related to physical resources and processes related to Cloud Services. This ontology underpins the security properties and resource types used across different cloud environments and certification catalogues.

6.1.1 Industrial panel in CLOSER 2025: “Cybersecurity certification for the Computing Continuum: Future Challenges and Opportunities”

After the establishment of the EC3 and onboarding of the first projects into it, the cluster was publicly launched in CLOSER 2025, through the organization of an industrial panel on the 1st of

⁴⁰ <https://www.insticc.org/node/TechnicalProgram/closer/2025/presentationDetails/766>

⁴¹ <https://github.com/Cybersecurity-Certification-Hub>

April 2025. The panel counted with the organization and participation of representatives of 5 projects from the cluster (EMERALD, COBALT, TELEMETRY, CERTIFY, and CONFIRMATE), with the main objective of increasing the visibility and awareness of the activities and outcomes of the different projects. The panel offered a comprehensive analysis of key cybersecurity certification challenges within the European Computing Continuum such as continuous certification, AI enhanced certification and trusted IoT supply chains, among others.

Over the course of 2 hours, the panellists provided a debriefing of the current state of cybersecurity certification. They discussed the most pressing challenges, explored new avenues of research, and delved into potential strategies to strengthen the security posture in the computing ecosystem. Figure 24 shows the implemented agenda.



Figure 24. Implemented agenda in the CLOSER 2025 industrial panel

First, the EC3 cluster was introduced by Juncal Alonso (chair of the panel and Coordinator of the EMERALD project) to the audience, explaining its main objectives: identifying **key challenges** and opportunities for enhancing **cybersecurity certification** and serving as a **hub** to multiply the synergies in the **projects** working on those topics.

Then, the three panellists, namely, Antonio Skarmeta (representing COBALT, TELEMETRY and CERTIFY), Christian Banse (representing CONFIRMATE) and Bjorn Fanta (representing EMERALD) joined the discussion exploring the future of cybersecurity certification in the Computing Continuum from the perspective of the three projects.

To finish, in addition to the experts panel discussion, the floor was opened to the audience for questions and comments. Lively and interesting discussions were held during more than 30 minutes with different stakeholders from the academic and the industrial side.



Figure 25. EC3 kick-off in the CLOSER 2025 conference

6.2 Networking with Other European Projects

Engaging with similar European projects in the fields of certification and cybersecurity provides valuable opportunities to exchange knowledge, share best practices, and address common technical challenges. Table 7 provides a list of projects with which EMERALD is currently collaborating. For each project, the table includes its name, objectives, and the joint activities carried out so far.

In total, EMERALD is in contact with 9 projects, each focusing on different aspects of cybersecurity and certification. Key activities include participation in various webinars and working groups, development of shared resources, such as the metric repository, and collaborative meetings among project partners. Notable activity includes engagement with the EC3, which has already been described in Section 6.1.

Table 7. Projects collaborating with EMERALD

Project	Objective and scope	Joint activities
ECCO: European Cybersecurity Community 	This project, led by ECSO, aims to enhance the Cybersecurity Competence Community at the European level and improve cooperation between public and private cybersecurity initiatives in Europe.	• Joined ECCO working group • Participation in the ECCO webinar “Cloud / Edge Security Challenges” (see Section 5.5)

Project	Objective and scope	Joint activities
COBALT: Certification for Cybersecurity in EU ICT using Decentralized Digital Twinning 	COBALT seeks to enhance cybersecurity standards, fostering a future where certifications are widely recognized and trusted. By aligning with initiatives like the EU CSA, ENISA, EUCS, and EUCC, the project acts as a catalyst for harmonizing cybersecurity practices.	• 2 meetings among a subset of projects' partners • EC3 participation • Development of a shared metric repository • CLOSER 2025 panel
CERTIFAI: Agile conformance assessment for cybersecurity CERTIFICATION enhanced by Artificial Intelligence (AI) 	CERTIFAI aims to develop an open software framework that leverages AI-driven, cost-efficient continuous assessment and re-certification methods for ICT products, processes, and services. This proactive approach ensures robust compliance throughout the product lifecycle, addressing the evolving cybersecurity landscape.	• A meeting among a subset of projects' partners • EC3 participation
CERTIFY: aActive sEcurity foR connectEd devices liFecYcles 	CERTIFY establishes a methodological, technological, and organizational approach to IoT security lifecycle management, aiming to enhance security by effectively detecting and responding to a wide range of attacks.	• IoTday online webinar (see Section 5.5) • EC3 participation • CLOSER 2025 panel
DOSS: Secure-by-Design IoT operation with Supply Chain Control 	The DOSS project focuses on enhancing the security and reliability of IoT operations. The project develops a secure-by-design approach and implements supporting technologies, including structured data exchange, component testing, and architecture modelling.	• IoT day online webinar (see Section 5.5) • EC3 participation
TELEMETRY: Cybersecurity via trustworthy tools and methodologies is a crucial challenge for IoT ecosystems	The TELEMETRY project addresses the critical challenge of cybersecurity in IoT ecosystems by developing and validating innovative tools and methods for testing and detecting security	• IoT day online webinar (see Section 5.5) • EC3 participation • CLOSER 2025 panel

Project	Objective and scope	Joint activities
 TELEMETRY	vulnerabilities in IoT devices and systems.	
CONFIRMATE: CONFormlty assessment, metRics and compliance autoMATION for the cyber resilienceE act 	CONFIRMATE is an EU-funded project designed to simplify compliance with the Cyber Resilience Act (CRA). The initiative focuses on developing open-source tools and automation solutions to enhance cybersecurity resilience. By bringing together leading organizations, CONFIRMATE aims to standardize testing procedures, provide guidance, and support businesses in meeting CRA requirements.	• A meeting among a subset of projects' partners • CLOSER 2025 panel
DOME: A Distributed Open Marketplace for Europe Cloud and Edge Services 	The aim of DOME is to support businesses and public organisations digital transformation making available a catalogue of cloud-to-edge offerings in Europe. DOME offers a compliance model for to ensure cybersecurity posture of the services in the marketplace.	• EMERALD was presented in the kick off meeting of the DOME project by TECNALIA and several partners have been redirected to the EMERALD resources for more detail
NexusForum.EU: Consolidating Research and Policy along the Cognitive Computing Continuum 	NexusForum.EU will boost the consolidation of the European Computing Continuum ecosystem building on the valuable activities and impact generated so far within the existing EUCloudEdgeIoT (EuCEI) initiative, as well as provide a forward-looking and bold vision in new areas and directions that have not been explored so far.	• EMERALD was presented in NexusForum.eu summit in 2024. • EMERALD plans to contribute in NexusForum.eu cybersecurity working group to provide feedback on the roadmap.

6.3 Networking with Other Initiatives

European Telecommunications Standards Institute (ETSI)

EMERALD networks with the European Telecommunications Standards Institute (ETSI) Technical Committees CYBER and SAI through its partner Fabasoft, an active ETSI member. Within this collaboration, EMERALD contributes its research findings on advanced security evidence management, including novel approaches for traceability and automation through CertGraph, as well as the use of interoperable formats such as OSCAL (Open Security Controls Assessment Language). These contributions support ongoing standardization efforts around trustworthy

cloud certification and AI system assurance, enabling more transparent and efficient assessment processes across Europe. These activities are described in section 5 of the deliverable D6.6 Exploitation report v1 [3].

EU Alliance for Industrial Data, Edge and Cloud

EMERALD is also preparing a collaboration with the EU Alliance for Industrial Data, Edge and Cloud, aiming to align its work on automated compliance and certification with broader European industrial priorities. By contributing insights from its security evidence management framework, CertGraph visualizations, and the use of OSCAL for structured control representation, EMERALD supports the Alliance's goals of building a trusted, sovereign cloud and edge infrastructure. This engagement helps ensure that EMERALD's innovations are integrated into key strategic initiatives shaping the future of secure and interoperable digital services in Europe.

EUROSCAL

EMERALD is actively integrating the Open Security Controls Assessment Language (OSCAL) to standardize and automate its cloud compliance processes, thereby fostering seamless interoperability and continuous certification. More specifically, EMERALD has adopted OSCAL to exchange information on the security control schemes managed in EMERALD. EMERALD continues this collaboration through the maintenance and management of the EUROSCAL initiative (<https://euroscal.eu/>).

Gaia-X

Several members of the EMERALD consortium are part of the Gaia-X initiative, including TECNALIA, the coordinator of the action. During the first eighteen months of the project informal collaboration has happened between the two actions, mainly in terms of awareness and visibility of the EMERALD outcomes in the Gaia-X ecosystem.

6.4 External Advisory Board

The EMERALD project has set up an External Advisory Board (EAB) to offer insights and guidance on research and innovation related to cloud certification. As stated in the DoA [4], the EAB includes 5 recognized external independent experts from academia, industry, and the standardization sector. The fields of expertise range from cyber security standardization to legal and audit aspects as well as operative security implementation.

So far, two sessions have taken place: the first in June 2024, serving as a kick-off and introduction to the project (see Figure 26), and the second in January 2025, where the initial results of the first year were presented, and valuable feedback was gathered (see Figure 27).

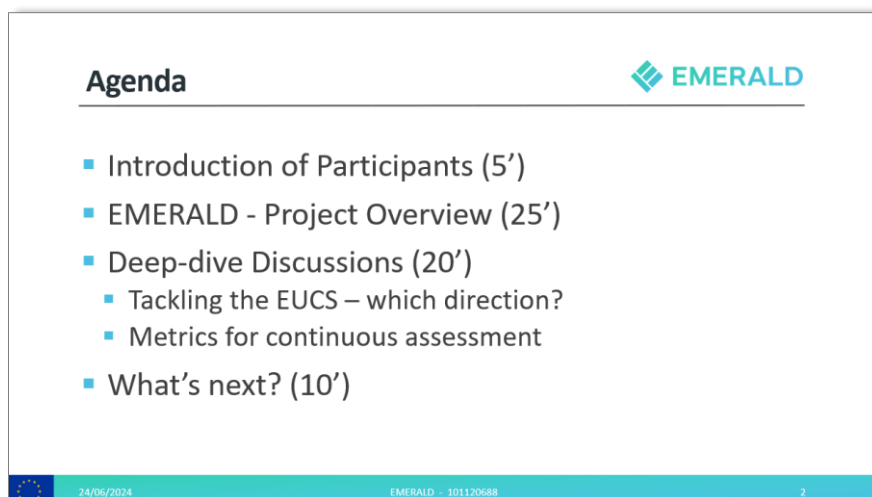


Figure 26. Agenda for the first EAB meeting

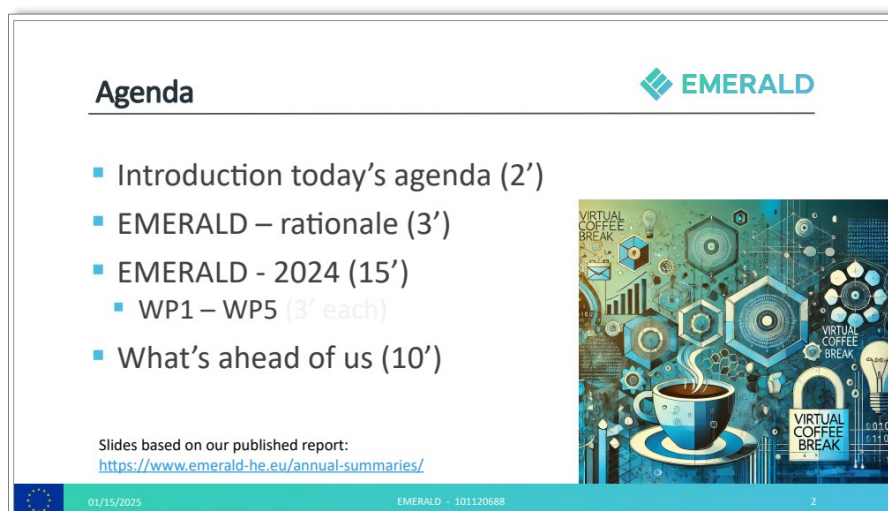


Figure 27. Agenda for the second EAB meeting

To facilitate engagement and knowledge exchange, from January 2025, the EAB meetings are structured as *Coffee Break Sessions*, held quarterly in an online format. Each session lasts 45 minutes and follows a structured agenda: a 15 minute deep-dive into a specific topic, 25 minutes of discussion, and 5 minutes dedicated to planning future activities.

The upcoming sessions will continue this format, with the next scheduled for May 2025, focusing on CertGraph, followed by a session in July 2025, which will explore user journeys. Future topics will be determined based on the evolving needs of the project and the input from EAB members.

7 Progress on KPIs and Adjustment of strategies

This section presents the values of the key performance indicators (KPIs) achieved for communication, dissemination and networking defined in deliverable D6.2 [1]. The value of each KPI is analysed, and, if necessary, corrective actions are proposed for those that have not been fully met. Table 8 shows the symbols used to explain whether a criterion has been met or not.

Table 8. Explanation symbols for the KPIs

	Criterion has already been met
	Criterion has not yet been reached, but the results are average for the period
	Criterion has not yet been achieved, and corrective actions are needed to ensure it
	The criterion is no longer relevant as the corresponding KPI is being removed

7.1 KPIs progress

The KPIs are divided according to communication, dissemination and networking activities (see Table 9, Table 10, and Table 11, respectively). The columns in each table show the tool used for the measurement of the KPI, a brief description of the KPI, the target value set for the whole duration of the project, the current value achieved up to month eighteen, and the current status. **As of month eighteen, 12 out of 20 KPIs have already been achieved**, 8 out of 20 are in progress, and none have been completely missed. For each KPI, an analysis and discussion is provided in Section 7.2.

Table 9. EMERALD KPIs for communication and their status in month eighteen

Tool	KPI	Objective (M1-M36)	Done (M1-M18)	Status
EMERALD website	Yearly visits	>1,500	2,228	
	Duration of visits	More than 2 min. for 40% of users	Average: 1m 03s	
	Monthly downloads: • Posters, flyers • Public reports	30 (posters, flyers/press releases) 50 (public reports)	342 (total number of downloads)	
Social media X	Regular tweets or when a relevant milestone is taking place (e.g., event, releases, etc.)	> 200 followers	34	
		>= 36 posts	44	
Social media LinkedIn	Regular posts whenever a relevant milestone is taking place (e.g., event, releases, etc.)	>= 36 posts	65	

Tool	KPI	Objective (M1-M36)	Done (M1-M18)	Status
Flyers	Number of flyers produced	>= 3 1. CNR 2. Fabasoft 3. Tecnia	1	
Press releases	Number of specialized press releases	>= 2 per country in the project, translated into the partners language	1 (consortium) 2 (partners)	
EMERALD fragments	Number of entries	>= 6 per year	35	

Table 10. EMERALD KPIs for dissemination and their status in month eighteen

Tool	KPI	Objective (M1-M36)	Done (M1-M18)	Status
Journal publications	N. of publications submitted to international scientific journals	>= 2	1	
Conference publications	N. of publications accepted by international scientific conferences	>= 10	4	
EMERALD News (Annual Summary)	N. of annual summaries published	= 1 per year	1	
Posters	N. of posters related to EMERALD	>= 1 per year	3	
Project showcases	N. of demonstration videos produced	>= 6	2	
Participation in events	N. of events attended in which EMERALD (or parts of) is presented or exhibited	>= 5 per year	15	
Cloud Community Publications	Number of references in external sources (e.g., project websites, Collaboration and Support Actions)	> 15	23	

Table 11. EMERALD KPIs for networking and their status in month 18

Tool	KPI	Objective (M1-M36)	Done (M1-M18)	Status
Technological collaborations	Join forces in enhancing and developing	At least one technological asset	Security metrics repository (WIP)	
Co-organized events	Workshops and/or satellite events and/or joint sessions	>= 2	3	

Tool	KPI	Objective (M1-M36)	Done (M1-M18)	Status
Joint dissemination	Joint papers and/or news articles	≥ 2	1 (EC3 website)	
Working groups	Participation in working groups	≥ 3	3	

7.2 Adjustments and Future Roadmap

As shown in the previous tables, some of the KPIs have not been achieved yet. In the following, a broader overview of all the tools is provided and, for each tool, a brief explanation of why the KPI has not been reached (where applicable) and the future plans for achieving it.

EMERALD Website

The EMERALD website has performed well, exceeding the target of 1,500 yearly visits. However, the average duration of user visits fell short of the goal, suggesting that additional efforts are needed to enhance engagement on the platform. Despite this, the website remains a key tool for the project's visibility, and further optimization efforts will continue to improve its impact.

Social Media X

The X platform has proven to be less effective for disseminating the project's activities, as reflected by the low number of followers, which currently stands at just 34, far from the 200 followers set in the KPI. This underperformance can be attributed to several factors, including recent shifts in the platform's user base, which no longer seem to align with the project's target audience. Additionally, changes in the platform's features and management have led to a decline in its relevance for reaching professionals interested in research and innovation. Considering these trends and the consistent underperformance, the EMERALD consortium has decided to deactivate the X account. Moving forward, we will refocus our dissemination efforts on LinkedIn, a platform better suited for professional engagement and project visibility.

Social Media LinkedIn

LinkedIn is currently performing very well in terms of both the number of posts and overall engagement. The initial objectives set for this channel have already been significantly exceeded. As a result, all future focus and efforts will be concentrated on LinkedIn, which has proven to be an effective platform for achieving our communication goals.

Flyers

The KPI for flyers has not yet been achieved, however, this is not a cause for concern. A clear plan is already in place for the release of two additional flyers, which will be published by the end of July 2025 and during the project's final phase, respectively.

The second flyer will focus on the integrated version of the EMERALD framework, recently made available, and will highlight its main components and functionalities. The third and final flyer will be released during the last phase of the project and will present a comprehensive overview of the results achieved, together with the project's overall impact.

Press Releases

The objectives initially set for the press releases have already been successfully achieved. Nevertheless, at least one additional press release is planned towards the end of the project,

with the aim of announcing the results obtained and further reinforcing the project's visibility and impact.

EMERALD Fragments

The objective set for the EMERALD fragments has been successfully met. Website analytics indicate that these blog-style posts are highly effective in disseminating updates and insights about the ongoing activities within the project. They have proven to be a valuable tool for enhancing transparency and engagement with stakeholders.

Journal and conference publications

The KPI for journal and conference publications has not yet been fully achieved, with conference publications slightly below the expected average for this period. However, this does not raise concern for two main reasons. Regarding journal publications, the time required for submission and acceptance of an article is lengthy, particularly in the fields of computer science and information engineering, where the review process can take several months. Nevertheless, one journal article has already been accepted, and we expect at least one more to be submitted before the project's completion. As for conference publications, it is common in the early stages of a project to experience a period of preparation and setup before publications can be finalized. In addition to the papers already published, several conference papers have been planned for the current year, with additional ones expected in the upcoming year, so we can expect that this KPI will be fulfilled.

EMERALD News (Annual Summary)

EMERALD News is currently on track, with progress aligning well with the planned objectives. Two additional brochures have been scheduled with an annual release cadence, ensuring consistent updates and visibility throughout the remaining duration of the project.

Posters

The objectives for the posters have been achieved and even exceeded. Nevertheless, efforts will be made to encourage the presentation of additional posters, to further enhance the dissemination and visibility of the project's results within relevant scientific and professional communities.

Project showcases

The production of project showcases is planned for the later stages of the project. These showcases, in the form of demonstration videos, will be created to highlight the achieved results, developed prototypes, and the proposed framework in an engaging and accessible way. For this reason, we expect that, in the second half of the project, more videos will be produced to effectively showcase the advancements and outcomes as they reach a more mature stage.

Events

The participation in events is on track with the planned objectives, ensuring a consistent presence at both scientific and stakeholder-oriented conferences. Efforts will continue to be made to attend additional relevant events, with the aim of maximizing the project's outreach, fostering collaboration, and sharing key results with diverse audiences.

Cloud Community Publications

Cloud community publications are on track with the expected objectives, with the project being mentioned or referenced in external sources. These mentions contribute to increasing the project's visibility and within the community. Further opportunities for external referencing will continue to be encouraged.

Technological collaborations

Regarding technological collaboration, significant progress has been made in establishing a shared repository for security metrics, which is now in its finalization phase. This repository has been developed in collaboration with a sister project, COBALT, and is intended to serve as a common reference point for security metrics used in certification processes. By consolidating relevant security metrics, it aims to facilitate a more structured and consistent approach to continuous certification. Moving forward, all projects within the EC3 will actively contribute to and benefit from this repository, fostering a collaborative effort towards enhancing security certification methodologies.

Co-organized events

Three co-organized events have been successfully carried out, exceeding the initial objectives. These events are reported in Section 5.5 and include the following:

- *Webinar: "Cloud / Edge Security Challenges"*. Organized in collaboration with the ECCO project (European Cyber Security COMMunity), this online webinar took place on **November 12, 2024**. It brought together industry experts to discuss pressing security issues in cloud and edge environments.
- *Panel: "Cybersecurity certification for the Computing Continuum: Future Challenges and Opportunities"*. Held during **CLOSER 2025** in **Porto, Portugal**, from **April 1–3, 2025**, this panel addressed emerging challenges in certification across computing layers.
- *Webinar & Roundtable: "Latest research results in IoT Supply Chain security to ensure compliance with the CRA"*. Conducted online as part of **Global IoT Day 2025** on **April 9, 2025**, this event focused on aligning research outcomes with upcoming regulatory requirements. It was co-organized with six European projects⁴².

Furthermore, we remain committed to organizing additional events in the future, collaborating closely with other European projects to foster knowledge exchange, enhance synergies, and address emerging challenges.

Joint dissemination

Regarding joint dissemination, a first major effort has been dedicated to the creation of a website to support the EC3. This platform serves as a central hub for sharing information and fostering collaboration among projects within the cluster. Looking ahead, we expect that at least some joint publications will emerge by the end of the project, further strengthening the collective dissemination impact.

⁴²<https://iotday.org/events/2025/iot-day-2025-webinar-roundtable-latest-research-results-in-iot-supply-chain-security-to-ensure-compliance-with-the-cra/>

Working groups

EMERALD is actively participating in three working groups that focus on key areas aligned with its objectives, including cloud certification, cybersecurity, and continuous compliance:

- **The European Cybersecurity Community Support project (ECCO)** is a coordination/support action that aims to strengthen collaboration across the European cybersecurity landscape by connecting key stakeholders, including EU-funded projects, public institutions, and private organizations. EMERALD actively engages in ECCO's ecosystem. Through participation in thematic groups and joint events such as webinars, EMERALD benefits from enhanced visibility, shared knowledge, and opportunities to align with emerging European cybersecurity priorities.
- The **European Telecommunications Standards Institute (ETSI)** is a recognized European Standards Organization responsible for developing globally applicable standards for information and communication technologies, including telecommunications, broadcasting, and other electronic communications networks and services. ETSI operates through various technical groups, such as Technical Committees and Industry Specification Groups, each focusing on specific areas like cybersecurity, IoT, and 5G. Members of the EMERALD project have initiated contact with ETSI to participate in relevant working groups that align with EMERALD's focus on cloud certification and continuous compliance. Participation in these working groups would allow EMERALD to contribute to the development of standards that support its objectives.
- **BITKOM**, Germany's digital association, represents over 2,000 companies in the digital economy, including SMEs, startups, and global players. It works to promote digital transformation across all sectors and fosters dialogue between business, society, and policy-makers. Bitkom encompasses various working groups that align with EMERALD's focus on cloud certification and continuous compliance, and it is also involved in initiatives like Gaia-X. Members of the EMERALD project have identified potential synergies with Bitkom's working groups, particularly those aligned with EMERALD's objectives around cloud certification and continuous compliance. Participation in these groups would allow EMERALD to contribute to ongoing discussions on trust, certification frameworks, and interoperability, while also gaining visibility within the German and broader European digital ecosystems, fostering collaborations that align with its mission.

Finally, we do not see, as of April 2025, any specific reason to change the established dissemination and communication plan defined in D6.2 [1].

8 Conclusions

This deliverable provides an overview of the communication, dissemination, and networking activities carried out during the first eighteen months of the EMERALD project. All partners have actively contributed to these efforts, either as participants or leaders, ensuring that key milestones were met. The successful achievement of most KPIs (12 out of 20) after eighteen months indicates that the strategy defined in D6.2 [1] is effective. A comparison between expected and actual results shows that the dissemination and communication plans are well-aligned with the project's goals, with no immediate need to revise these plans.

The **EMERALD website** has performed well, exceeding the target of 1,500 yearly visits and reaching almost 2,500 visits by month eighteen.

In terms of **social media**, the project made notable strides on **LinkedIn**, where content sharing has proven successful, with more posts than initially planned. On the other hand, the use of **X** has been less effective, with the project falling short of its follower target. This underperformance can be attributed to changes in the platform's user base, which no longer aligns as closely with the project's target audience. As a result, the focus will shift towards LinkedIn, where professional engagement is stronger and more aligned with the project's goals.

The production and dissemination of **flyers** has proceeded as planned, with one already produced for this period. Additionally, two more flyers are in the pipeline, set to be released in conjunction with significant milestones of the project. These flyers will help meet the planned dissemination goals for the second phase of the project.

In terms of **publications**, while the project has seen some success with **one journal** article already accepted and more expected, the overall number of academic publications is still in progress. The peer-review process in fields like computer science can take time, but the project anticipates that the remaining publications will be submitted by the end of the project. Similarly, the number of **conference presentations** is on track, with more papers planned for upcoming events.

Regarding **project showcases**, the creation of demonstration videos has begun, but the full set of videos will be produced in the second half of the project, as new results and prototypes are finalized. These videos will serve as a powerful tool to communicate the project's progress and key achievements to a wider audience.

On the **networking** side, the project has been successful in organizing several joint events and collaborating with other initiatives. While the production of joint publications has been slower than planned, efforts are ongoing to increase collaborative dissemination as the project moves forward.

Finally, the **technological collaborations** have progressed well, with the final stages of a shared security metrics repository underway. This initiative, developed in collaboration with sister projects, will serve as a valuable resource for advancing security certification processes and fostering ongoing collaboration within the research community.

In conclusion, while some activities are still in progress, the project is on track to meet all its communication, dissemination and networking objectives by the end. A final report on these activities will be presented in D6.5 [2], where the overall outcomes will be documented in detail.

9 References

- [1] EMERALD Consortium, “D6.2 Dissemination and Communication Strategy,” 2024.
- [2] EMERALD Consortium, “D6.5 Dissemination and Communication Report - v2,” 2026.
- [3] EMERALD Consortium, “D6.6 Exploitation Report - v1,” 2025.
- [4] EMERALD Consortium, “EMERALD - Annex 1 - Description of Action - GA 101120688,” 2022.
- [5] EMERALD Consortium, “D6.1 Project flyer and public website,” 2024.

APPENDIX A Flyer

This section contains the first flyer⁴³ produced for the project. Figure 28 and Figure 29 show the outer and inner panels, respectively.

PARTNERS

tecnalia TECNALIA is the largest centre of applied research and technological development in Spain. It provides specific solutions to the major global challenges and transforms technological research into prosperity.

Fraunhofer AISEC FRAUNHOFER AISEC, a leader in cybersecurity research, develops customized security concepts and solutions to protect businesses and the public sector against cybercrimes and to enhance data security.

Fabasoft Fabasoft PROCESO is a unique business ecosystem providing selected, powerful and seamlessly integrated solutions for document-intensive business processes.

CNR CNR is the largest public research institution in Italy. Founded in 1953 it is focused on carrying out, disseminating and enhancing scientific and technological research in the main fields of knowledge.

SCCH SCCH is a non-profit COMET center that focuses on data and software science. Excellent research is conducted in both areas at SCCH. SCCH was founded by the Johannes Kepler University Linz in 1999.

Know Center The Know Center is a leading European innovation and research center for trustworthy AI and data science.

CaixaBank CaixaBank is the leading financial group in Spain and one of the most significant in Portugal. Constantly striving for the innovation, it will provide a large experience on cybersecurity in finance.

IONOS IONOS is the leading European digitalisation partner for small and medium-sized businesses (SMBs).

CloudFerro CloudFerro provides innovative cloud services. The company delivers and operates cloud computing platforms for demanding markets, such as the European space sector, climate research and science.

OpenNebula Systems OpenNebula Systems is the deep tech company behind OpenNebula, the only European open source Cloud & Edge Computing Platform in the market and a success story of EU-funded research and innovation.

NIXU NIXU, a DNV company, is a trusted cybersecurity services partner. We help our customers ensure business resilience with peace of mind across multiple industries, enabled by some of the best cybersecurity professionals in Europe.

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PROJECT INFO

Overall budget: € 5,498,900
Start date: Nov '22
End date: Oct '26
Coordinated by: FUNDACIÓN TECNALIA RESEARCH & INNOVATION
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Funded by the European Union

EMERALD
Evidence Management for Continuous Certification as a Service in the Cloud

Figure 28. Outer panels of the first EMERALD flyer

OBJECTIVES

1 Provide next generation evidence gathering tools based on a knowledge graph approach.
KR1 EXTRACT: A framework to continuously extract knowledge on various layers of the cloud service and prepare suitable evidence based on them.
KR2 CERTGRAPH: A graph-based structure, the certification graph, to consolidate all necessary information of the service and make it easily query-able.

2 Reduce complexity in multi-scheme Cloud certifications by assisted metric mapping.
KR3 OPTIMA: An intelligent system to select an optimized set of metrics that can be measured to demonstrate compliance to the selected certification scheme.
KR4 MULTICERT: A tool to assess chosen metrics based on information stored in the certification graph and to evaluate the final certificate decision.
KR5 AIPOC: A proof of concept (PoC) on how to scale the CaaS approach to cloud-based AI systems.

3 Provide a seamless user experience of continuous auditing for auditors and auditees.
KR6 EMERALD UI/UX: A user interaction concept and conducted studies to show what information each user needs in an audit process.

4 Provide interoperability to other frameworks, security assessment tools and repositories.
KR7 INTEROP: An interoperability layer, the trustworthy systems, assessment results and catalogue data.

5 Validate the outcomes in industrial pilots.
KR8 PILOTS: Involvement of realistic use cases by potential applicants of EMERALD.

6 Promote the project, disseminate results and coordinate with international agencies.
KR9 DECAS: Dissemination and communication of results via multiple channels, relevant conferences and the scientific community. Exploitation of achievements by the technical and pilot partners. Standardization activities to discuss, verify and deepen the findings with standardization bodies.

BENEFITS

Provide novel techniques on the assessment of AI models [KR5-AIPOC] specific to the robustness of ML systems, their interpretability, and the mitigation of potentially negative impacts such as model unfairness.

Explore for existential overlap between cloud certifications and AI-based certifications with the aim of evidence re-usability in a multi-certification scenario [KR4-MULTICERT].

Integrate evidence collection techniques into a single graph-based structure, the Certification Graph [KR2-CERTGRAPH].

Develop a holistic security evaluation approach for ML models by making scientific findings applicable in the real world.

Improve and extend existing evidence collection techniques, mainly organisational evidence extraction like done in AMOE.

Offer a concept for a UI to address certification-as-a-service (CaaS) and its continuous and lean re-certification aspects focused on the user [KR6-EMERALD UI/UX].

Put in place a co-design approach that combines empirical social enquiry and computational approaches to investigate requirements, work-related phenomena, interdependencies in work processes and the available technologies to obtain a holistic view of the current state of practice.

THE PROJECT

The main objective of EMERALD is to pave the road towards Certification-as-a-Service (CaaS) for continuous certification of harmonized cybersecurity schemes, like the European Cybersecurity Certification Scheme for Cloud Services (EUCS).

Addressed users of such a CaaS solution are stakeholder groups of the cybersecurity domain: cloud service providers, cloud customers, auditors, and standardization agencies.

For cloud service providers as well as cloud customers, EMERALD will offer a framework to set-up, manage and monitor their certifications and enable lean re-certification.

For auditors, EMERALD will be an audit assistance framework.

To achieve the overall objective, EMERALD will design and implement a user interaction concept, offering a uniform way to address audits and offer the above mentioned stakeholders a solid degree of complexity reduction through the customization of the audit process.

Lastly, EMERALD will provide cybersecurity and standardization agencies with novel strategies and methods for building cybersecurity requirements and metrics that can react to changes and, if necessary, are interoperable enough to be translated to other schemes.

Figure 29. Inner panels of the first EMERALD flyer

⁴³ <https://www.emerald-he.eu/flyers/>

APPENDIX B Press Release in different languages

The following figures (from Figure 30 to Figure 34) show the content of the first EMERALD press release translated into the different languages of the partners, namely in Finnish⁴⁴, German⁴⁵, Italian⁴⁶, Polish⁴⁷, and Spanish⁴⁸.



Lehdistötiedote

EMERALD parantaa pilvipohjaisten palvelujen turvallisuutta ja tehokkuutta tarjoamalla uuden kehikon suurten ja PK-yritysten käyttöön

Espoo, Suomi, helmikuu 2024.

Viime vuosina pilvipohjaisten palveluiden ja sovellusten kehittämiseen nojaava liiketoiminta on kasvanut huomattavasti sekä suurissa että pienissä/keskisuurissa yrityksissä (pk-yrityksissä). Tämän seurauksena pilvipohjaisten palvelujen sertifiointiprosessista oli tehtävä joustavampi esimerkiksi käyttämällä jatkuvaa seuranta- ja arviointia, kuten EU:n kyberturvallisuusasetus (CSA) on todennut. Vaikka teknologian näkökulmasta on esitetty erilaisia todisteita jatkuvan seurannan ja arvioinnin konsepteista, käytettyjen eri teknologien yhteentoimivuuteen liittyy edelleen joitakin haasteita.

Yritysten on noudatettava monenlaisia turvallisuutta, yksityisyyttä ja sääntelyä koskevia vaatimuksia heterogeenisissä ympäristöissä, minkä vuoksi erittäin säänneltyn toimialojen on monimutkaista ja kallista integroida uusia palveluja ja arvioida ja valvoa jatkuvasti tällaisia vaatimuksia. Palvelujen itsemuutuvuuden ja tietojen siirrettävyyden saavuttamiseksi tarvitaan uusia strategioita, jotka auttavat kehittäjiä suunnittelemaan ja toteuttamaan turvallisia palveluja.

Uutta tutkimushanketta, nimeltään **EMERALD (Evidence Management for Continuous Certification as a Service in the Cloud)**, on rahoitettu Euroopan unionin Horizon Europe -ohjelmasta avustussopimuksen 101120688 mukaisesti. EMERALD on keskittynyt pilvipohjaisten palvelujen toimintaympäristön muuttamiseen keskittymällä kehittämään uutta kehikkoa iturallisuuden ja tehokkuuden parantamiseksi sekä suurissa että PK-yrityksissä. EMERALD on sitoutunut kehittämään ketterän sertifiointiprosessin, joka tukee pilvipalvelujen tarjoajia, asiakkaita ja audittoijia sertifiointiprosessissa. Samalla hanke edistää pilvipalveluiden käyttöönottoa ja auttaa varmistamaan niiden saatavuuden, turvallisuuden ja hyödyllisyyden kaikille sidosryhmille.

EMERALDin pääavoite on **tasolta tietä kohti Sertifiointi palveluna -ratkaisua (Certification-as-a-Service, CaaS)** yhdenmukaistettujen kyberturvallisuusjärjestelmien, kuten EUCS:n (European Cybersecurity Certification Scheme for Cloud Services), jatkuvaa sertifiointia varten. Tätä varten EMERALD-hankkeessa hyödynnetään Horizon 2020 MEDINA-hankkeen (GA 952633) tuloksia aikaaan teknologian valmiustasosta TRL 5 (prototyyppi) ja edeten EMERALDissa TRL 7:ään (tuote).

Pilvipalvelujen tarjoajat ja loppuasiakkaat hyötyvät merkittävästi EMERALDin tarjoamasta kehikosta, joka mahdollistaa sertifiointien toteuttamisen, hallinnan ja seurannan sekä mahdollistaa kustannustehokkaan uudelleen sertifiointin. Audittoijille EMERALD-järjestelmä tarjoaa apuvälineet helpottamaan auditointiprosessia.

EMERALD suunnittelee ja toteuttaa uuden käyttäjän vuorovaikutuskonseptin, joka tarjoaa yhdenmukaisen tavan käsitellä auditointia ja vähentää huomattavasti monimutkaisuutta mukauttaen auditointiprosessia. Lisäksi EMERALD tarjoaa **kyberturvallisuus- ja**

standardointivirastoille uusia strategioita ja menetelmiä kyberturvallisuusvaatimusten ja -metriikoiden luomiseksi, jotka ovat tarvittaessa yhteensopivia myös muihin vaatimuskehikoihin.

EMERALD:

- Tarjoaa seuraavan sukupolven todisteiden keruutyökalut, jotka perustuvat visuaaliseen "tietograafi"-lähestymistapaan.
- Vähentää työtä useamman pilvisertifiointin saamisessa, hyödyntäen metriikoiden samankaltaisuuksia.
- Tarjoaa audittoijille ja auditoitaville erinomaisen jatkuvan auditoinnin käyttökokemuksen.
- Parantaa yhteentoimivuutta myös muiden kehikkojen, turvallisuuden arviointivälineiden ja tietovarastojen kanssa.
- Validoi tulokset teollisissa pilloiteissa.
- Edistää hanketta, levittää tuloksia ja koordinoi yhteistyötä kansainvälisten organisaatioiden kanssa.

EMERALD-konsortio, jota johtaa Tcnalia (Espanja), on tasapainoinen joukko akateemisia ja teollisia kumppaneita, jotka ovat erikoistuneet esimerkiksi kyberturvallisuussertifiointiin, pilvipalveluihin, tekoälyn, UX/UI-suunnitteluun ja auditointiprosesseihin. Tämä monipuolinen asiantuntemus takaa vanhan lähestymistavan EMERALDin tavoitteiden saavuttamiseen keskittyen käytännön sovellettavuuteen ja tulosten varhaiseen käyttöönottoon. Konsortioon kuuluu 11 organisaatiota: Tcnalia, Fraunhofer, Fabasoft, Consiglio Nazionale delle Ricerche, Software Competence Center Hagenberg, Know Center, CaixaBank, IONOS, CloudFerro, OpenNebula ja Nixu.

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Figure 30. EMERALD Press Release translated into Finnish

⁴⁴ https://www.emerald-he.eu/wp-content/uploads/2024/04/EMERALD_Press_Release_Feb2024FIN.pdf

⁴⁵ https://www.emerald-he.eu/wp-content/uploads/2024/03/EMERALD_Press_Release_Feb2024DE.pdf

⁴⁶ https://www.emerald-he.eu/wp-content/uploads/2024/02/EMERALD_Comunicato_stampa_Feb2024IT.pdf

⁴⁷ https://www.emerald-he.eu/wp-content/uploads/2024/03/EMERALD_Press_Release_Feb2024PL.pdf

⁴⁸ https://www.emerald-he.eu/wp-content/uploads/2024/03/EMERALD_Nota_de_prensa_Feb2024ES.pdf



Pressemitteilung

EMERALD verändert die Landschaft der Cloud-basierten Dienste durch einen neuen Rahmen, um die Sicherheit und Effizienz für große Unternehmen und KMU zu verbessern.

Linz, Austria, March 2024.

In den letzten Jahren hat der Anteil der Unternehmen, die sich auf die Entwicklung von Cloud-basierten Diensten und Anwendungen verlassen, sowohl bei großen als auch bei kleinen und mittleren Unternehmen (KMU) erheblich zugenommen. Infolgedessen bestand die Notwendigkeit, den Zertifizierungsprozess für Cloud-basierte Dienste flexibler zu gestalten, z. B. durch den Einsatz einer kontinuierlichen Überwachung und Bewertung, wie die entsprechenden Verweise in der EU-Cybersicherheitsverordnung (EU CSA) zeigen. Aus technologischer Sicht wurden zwar verschiedene Konzeptnachweise für die kontinuierliche Überwachung und Bewertung erbracht, doch gibt es noch einige Herausforderungen im Zusammenhang mit der Interoperabilität der verschiedenen verwendeten Technologien.

Unternehmen sind gezwungen, in heterogenen Umgebungen ein breites Spektrum an Sicherheits-, Datenschutz- und Regulierungsanforderungen zu erfüllen, was es für stark regulierte Branchen komplex und kostspielig macht, neue Dienste zu integrieren und solche Anforderungen kontinuierlich zu bewerten und durchzusetzen. Neue Strategien zur Erreichung der Selbst-Adaptivität von Diensten und der Daten Portabilität sind erforderlich, um Entwickler bei der Konzeption und Implementierung sicherer Dienste zu unterstützen.

Ein neues Forschungsprojekt mit dem Namen **EMERALD (Evidence Management for Continuous Certification as a Service in the Cloud)** wurde durch das Programm Horizon Europe der Europäischen Union unter der Fördervereinbarung (GA) 101120688 finanziert. EMERALD widmet sich der **Umgestaltung der Landschaft der Cloud-basierten Dienste und konzentriert sich auf die Entwicklung eines neuen Rahmens zur Verbesserung der Sicherheit und Effizienz sowohl für große als auch für kleine und mittlere Unternehmen.** Mit der Entwicklung eines agilen Zertifizierungsprozesses wird EMERALD Anbieter von Cloud-Diensten, Kunden und Prüfer im Zertifizierungsprozess unterstützen, die Annahme von Cloud-Diensten fördern und sicherstellen, dass diese für alle Beteiligten zugänglich, sicher und vorteilhaft sind.

Das Hauptziel von EMERALD ist es, den Weg zu **Certification-as-a-Service (CaaS)** für die kontinuierliche Zertifizierung von harmonisierten Cybersicherheitssystemen zu ebnet, wie beispielsweise der **EUCS (European Cybersecurity Certification Scheme for Cloud Services)**. Zu diesem Zweck wird EMERALD die Ergebnisse des H2020-Projekts MEDINA (GA 952633) nutzen, und in Richtung Technology Readiness Level (TRL) 7 begleiten.

Sowohl für **Anbieter von Cloud-Diensten** als auch für **Cloud-Kunden** wird EMERALD einen Rahmen bieten, um ihre Zertifizierungen einzurichten, zu verwalten und zu überwachen und eine schlanke Rezertifizierung zu ermöglichen. Für **Auditoren** wird EMERALD einen Rahmen zur Unterstützung bei Audits anbieten.

Um das Gesamtziel zu erreichen, wird **EMERALD ein Konzept für die Benutzerinteraktion entwerfen und umsetzen**, dass eine einheitliche Vorgehensweise bei der Durchführung von Audits und ein solides Maß an Komplexitätsreduzierung durch Anpassung des Audit-Prozesses bietet. Darüber hinaus wird **EMERALD Cybersicherheits- und Normungsbehörden** mit neuartigen Strategien und Methoden zur Erstellung von Cybersicherheitsanforderungen und -metriken versorgen, die auf Änderungen reagieren können und, falls erforderlich, interoperabel genug sind, um auf andere Systeme übertragen zu werden.

In diesem Zusammenhang wird EMERALD:

- Werkzeuge der nächsten Generation zur Sammlung von Nachweisen auf der Grundlage eines Wissensgraphen bereitstellen.
- die Komplexität bei Cloud-Zertifizierungen mit mehreren Schemata durch eine unterstützte Zuordnung von Metriken verringern.
- eine nahtlose Benutzererfahrung für kontinuierliche Audits für Auditoren und Auditiertere bieten.
- Interoperabilität mit anderen Rahmenwerken, Sicherheitsbewertungswerkzeugen und Repositorien.
- Validierung der Ergebnisse in industriellen Pilotprojekten.
- Förderung des Projekts, Verbreitung der Ergebnisse und Koordinierung mit internationalen Agenturen.

Das von Tecnalia (Spanien) geleitete **EMERALD-Konsortium** besteht aus einer ausgewogenen Gruppe von akademischen und industriellen Partnern, die sich auf Bereiche wie Cybersicherheitszertifizierung, Cloud Computing, KI, UX/UI-Design und Auditverfahren spezialisiert haben. Dieses vielfältige Fachwissen gewährleistet einen robusten Ansatz zur Erreichung der EMERALD-Ziele, wobei der Schwerpunkt auf der praktischen Anwendbarkeit und der frühen Übernahme der Ergebnisse liegt. Dem Konsortium gehören 11 Organisationen an: Tecnalia, Fraunhofer, Fabasoft, Consiglio Nazionale delle Ricerche, Software Competence Center Hagenberg, Know Center, CaixaBank, IONOS, CloudFerro, OpenNebula und Nixu.

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Figure 31. EMERALD Press Release translated into German



Nota stampa

EMERALD trasforma il panorama dei servizi basati sul cloud sviluppando un nuovo framework per migliorarne la sicurezza e l'efficienza, sia per le grandi che per le Piccole e Medie imprese.

Pisa, Italia, Febbraio 2024.

Negli ultimi anni, il giro di affari che si basa sullo sviluppo di servizi e applicazioni basati sul cloud è aumentato notevolmente sia per le grandi che per le Piccole e Medie Imprese (PMI). Di conseguenza, si è sentita l'esigenza di rendere più agile il processo di certificazione dei servizi basati sul cloud, attraverso monitoraggi continui, in linea con le direttive contenute nell'EU Cybersecurity Act (EU CSA). Sebbene da un punto di vista tecnologico siano stati mostrati alcuni *proof of concept* per processi di certificazione basata sul continuo monitoraggio, esistono ancora molte sfide legate all'interoperabilità delle diverse tecnologie utilizzate.

Le imprese sono tenute a rispettare un'ampia serie di requisiti normativi, tra cui quelli relativi a sicurezza e privacy, in ambienti eterogenei, che rende complesso e costoso integrare nuovi servizi e al contempo monitorare continuamente l'assolvimento di tali requisiti. Per aiutare gli sviluppatori a progettare e implementare servizi sicuri, sono necessarie nuove strategie per ottenere l'auto-adattabilità dei servizi e la portabilità dei dati.

Un nuovo progetto di ricerca, denominato **EMERALD (Evidence Management for Continuous Certification as a Service in the Cloud)**, è stato finanziato dal programma Horizon Europe dell'Unione Europea con Grant Agreement 101120688. **EMERALD si propone di trasformare il panorama dei servizi basati sul cloud, concentrandosi sullo sviluppo di un nuovo framework per migliorare la sicurezza e l'efficienza sia per le grandi imprese che per le PMI.** Con l'impegno di sviluppare un processo di certificazione agile, EMERALD supporterà i fornitori di servizi cloud, i clienti e gli auditor nel processo di certificazione, promuovendo l'adozione di servizi cloud e garantendo che siano accessibili, sicuri e vantaggiosi per tutte le parti interessate.

L'obiettivo principale di EMERALD è quello di **aprire la strada alla Certification-as-a-Service (CaaS) per una certificazione di cybersecurity continua, ad esempio secondo quanto dettato dallo schema EUCS (European Cybersecurity Certification Scheme for Cloud Services)**. A questo scopo, EMERALD sfrutterà i risultati del progetto H2020 MEDINA (GA 952633), partendo dal "Technology Readiness Level" TRL 5 (prototipo) e avanzando in EMERALD fino al TRL 7 (prodotto).

Per i fornitori di servizi cloud e per i clienti cloud, EMERALD offrirà un quadro per impostare, gestire e monitorare le loro certificazioni e consentire una ri-certificazione snella. Per gli auditor EMERALD offrirà un quadro di assistenza per l'audit.

Per realizzare l'obiettivo generale, **EMERALD progetterà e implementerà un concetto di interazione con l'utente**, offrendo una modalità uniforme per affrontare gli audit e un consistente grado di riduzione della complessità attraverso la personalizzazione del processo. Inoltre, EMERALD fornirà alle **agenzie di cybersecurity e standardizzazione** strategie e metodi innovativi per la

creazione di requisiti e metriche di cybersecurity in grado di reagire ai cambiamenti e, se necessario, sufficientemente interoperabili per essere tradotti in altri schemi.

EMERALD è finalizzato a:

- Fornire strumenti di collezione di evidenze basati su un approccio graph knowledge-based.
- Ridurre la complessità delle certificazioni Cloud multi-schema grazie alla mappatura assistita tra requisiti di sicurezza e corrispondenti metriche.
- Fornire un'esperienza d'uso intuitiva nell'auditing continuo sia per gli auditor che per gli auditee.
- Fornire interoperabilità tra diversi framework di certificazione, strumenti di valutazione, e tipologia di dati.
- Convalidare i risultati in progetti pilota industriali.
- Promuovere il progetto, diffondere i risultati e coordinarsi con agenzie internazionali di settore.

Il consorzio EMERALD, guidato da Tecnalia (Spagna), è formato da un insieme equilibrato di partner accademici e industriali specializzati in aree quali la certificazione di requisiti di sicurezza informatica, il cloud computing, l'intelligenza artificiale, il design UX/UI e i processi di auditing. Queste competenze diversificate assicurano un solido approccio al raggiungimento degli obiettivi di EMERALD, con un'attenzione particolare all'applicabilità pratica e alla rapida adozione dei risultati. Il consorzio comprende 11 partners: Tecnalia, Fraunhofer, Fabasoft, Consiglio Nazionale delle Ricerche, Software Competence Center Hagenberg, Know Center, CaixaBank, IONOS, Cloudferry, OpenNebula e Nixu.

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Figure 32. EMERALD Press Release translated into Italian



Nota de prensa

EMERALD transforma el panorama de los servicios basados en la nube desarrollando un nuevo marco para mejorar la seguridad y la eficiencia tanto de las grandes como de las pequeñas y medianas empresas.

Derio, España, febrero 2024.

En los últimos años, el negocio que depende del desarrollo de servicios y aplicaciones basados en la nube ha aumentado considerablemente, tanto para grandes empresas como para pequeñas y medianas empresas (PYMES). Como resultado, ha surgido la necesidad de agilizar el proceso de certificación de los servicios basados en la nube, por ejemplo, mediante el uso de monitorización y evaluación continuos, tal como se evidencia en la Ley de Ciberseguridad de la UE (EU CSA). Aunque desde una perspectiva tecnológica se han realizado diferentes pruebas de concepto para el monitoreo y la evaluación continuos, todavía existen algunos desafíos relacionados con la interoperabilidad de las diferentes tecnologías utilizadas.

Las empresas se ven obligadas a cumplir con una amplia gama de requisitos de seguridad, privacidad y regulación en entornos heterogéneos, lo que complica y encarece la integración de nuevos servicios en industrias altamente reguladas, así como la evaluación y aplicación continua de dichos requisitos. Se requieren nuevas estrategias para lograr la adaptación de los servicios y la portabilidad de los datos, con el objetivo de ayudar a los desarrolladores a diseñar e implementar servicios seguros.

Un nuevo proyecto de investigación, denominado **EMERALD ("Evidence Management for Continuous Certification as a Service in the Cloud")**, ha sido financiado por el programa Horizonte Europa de la Unión Europea bajo el Acuerdo de Subvención 101120688. EMERALD se enfoca en **transformar el panorama de los servicios basados en la nube, centrándose en el desarrollo de un nuevo marco para mejorar la seguridad y la eficiencia tanto para las grandes como para las pequeñas y medianas empresas.** Con un compromiso de desarrollar un proceso de certificación ágil, EMERALD apoyará a los proveedores de servicios en la nube, clientes y auditores en el proceso de certificación, promoviendo la adopción de estos servicios y garantizando que sean accesibles, seguros y beneficiosos para todas las partes interesadas.

El principal objetivo de EMERALD es **allanar el camino hacia una Certificación como Servicio (CaaS) para la certificación continua de esquemas de ciberseguridad armonizados, tales como el esquema candidato EUCS ("European Cybersecurity Certification Scheme for Cloud Services")**. Para ello, EMERALD aprovechará los resultados del proyecto H2020 MEDINA (GA 952633), partiendo del nivel de preparación tecnológica TRL 5 (prototipo) y avanzando en el núcleo de EMERALD hasta el TRL 7 (producto).

Para los **proveedores de servicios en la nube**, así como para los **clientes de la nube**, EMERALD ofrecerá un marco para configurar, gestionar y supervisar sus certificaciones y permitir una recertificación eficiente. Por otro lado, para los **auditores**, EMERALD ofrecerá un marco de asistencia para realizar auditorías.

Para lograr este objetivo general, **EMERALD diseñará y aplicará un concepto de interacción con el usuario**, ofreciendo una forma uniforme de abordar las auditorías y reduciendo significativamente la complejidad al personalizar el proceso de auditoría. Además, EMERALD proporcionará a los **organismos de ciberseguridad y normalización** estrategias y métodos novedosos para establecer requisitos y métricas de ciberseguridad que puedan reaccionar ante los cambios y, en caso necesario, sean lo suficientemente interoperables como para ser trasladados a otros esquemas.

En este contexto, EMERALD llevará a cabo las siguientes acciones:

- Proporcionar herramientas de nueva generación para la recopilación de evidencias, basadas en un enfoque de grafos de conocimiento.
- Reducir la complejidad de las certificaciones en la nube de múltiples esquemas mediante un mapeo de métricas asistido.
- Ofrecer una experiencia de auditoría continua sin fisuras, tanto para auditores como para auditados.
- Garantizar la interoperabilidad con otros marcos, herramientas de evaluación de seguridad y repositorios.
- Validar los resultados en pilotos industriales.
- Promover el proyecto, difundir los resultados y coordinarse con agencias internacionales.

El consorcio EMERALD, liderado por Tecnalia (España), está formado por un conjunto equilibrado de socios académicos e industriales especializados en áreas como certificación de ciberseguridad, computación en la nube, IA, diseño UX/UI y procesos de auditoría. Esta diversidad de conocimientos garantiza un enfoque sólido para alcanzar los objetivos de EMERALD, con un enfoque en la aplicabilidad práctica y la adopción temprana de los resultados. El consorcio incluye 11 organizaciones: Tecnalia, Fraunhofer, Fabasoft, Consiglio Nazionale delle Ricerche, Software Competence Center Hagenberg, Know Center, CaixaBank, IONOS, Cloudferry, OpenNebula y Nixu.

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Figure 33. EMERALD Press Release translated into Spanish



Informacja prasowa

EMERALD zmienia krajobraz usług chmurowych, tworząc nowy framework zwiększający bezpieczeństwo i wydajność zarówno dużych, jak i małych oraz średnich przedsiębiorstw.

Warszawa, Polska, luty 2024 r.

W ostatnich latach obserwujemy rosnący rynek usług i aplikacji chmurowych, świadczonych zarówno przez duże, jak i małe oraz średnie przedsiębiorstwa (MŚP). W wyniku tych zmian, zaistniała potrzeba usprawnienia procesu certyfikacji usług opartych na chmurze, na przykład poprzez zastosowanie ciągłego monitorowania i oceny, o czym świadczy zaadresowanie tych kwestii w unijnym Akcie o Cyberbezpieczeństwie (EU CSA). Choć z technologicznego punktu widzenia przedstawiono różne dowody słuszności koncepcji ciągłego monitorowania i oceny, nadal istnieją wyzwania związane z interoperacyjnością różnych stosowanych technologii.

Firmy są zmuszone do przestrzegania szerokiego zakresu wymogów dotyczących bezpieczeństwa, prywatności i przepisów w heterogenicznych środowiskach, co sprawia, że dla branż podlegających ścisłym regulacjom, integrowanie nowych usług oraz ciągła ocena i egzekwowanie takich wymagań jest skomplikowane i kosztowne. Aby pomóc programistom w projektowaniu i wdrażaniu bezpiecznych usług, potrzebne są nowe strategie umożliwiające samoadaptację usług i przenoszenie danych.

Nowy projekt badawczy o nazwie EMERALD (z ang. *Evidence Management for Continuous Certification as a Service in the Cloud*) został sfinansowany w ramach unijnego programu „Horyzont Europa” w ramach umowy na grant 101120688. EMERALD ma na celu przekształcanie krajobrazu usług chmurowych, skupiając się na opracowaniu framework’u w celu poprawy bezpieczeństwa i wydajności, zarówno dla dużych, jak i małych oraz średnich przedsiębiorstw. Angażując się w rozwój sprawnego procesu certyfikacji, EMERALD będzie wspierać dostawców usług chmurowych, klientów i audytorów w procesie certyfikacji, promując przechodzenie na chmurę i zapewniając, że usługi te będą dostępne, bezpieczne i korzystne dla wszystkich interesariuszy.

Głównym celem projektu EMERALD jest utworzenie drogi w kierunku certyfikacji jako usługi (CaaS) w celu ciągłej certyfikacji zharmonizowanych systemów cyberbezpieczeństwa, takich jak EUCS (Europejski System Certyfikacji w zakresie Cyberbezpieczeństwa dla usług w chmurze). W tym celu projekt EMERALD wykorzysta osiągnięcia projektu MEDINA H2020 (GA 952633), zaczynając od poziomu gotowości technologicznej TRL 5 (prototyp) i przechodząc do TRL 7 (produkt).

Dostawcom usług chmurowych oraz ich klientom, EMERALD zaoferuje platformę do konfigurowania, zarządzania i monitorowania certyfikatów oraz umożliwi ponowną certyfikację. Audytorzy otrzymają natomiast ramowe wsparcie w zakresie audytu.

W ramach projektu EMERALD zostanie zaprojektowana i wdrożona koncepcja interakcji użytkownika, oferująca jednolity sposób przeprowadzania audytów i ograniczająca w znacznym stopniu złożoność poprzez dostosowanie procesu audytu. Ponadto projekt EMERALD zapewni agencjom zajmującym się cyberbezpieczeństwem i normalizacją nowatorskie strategie i metody tworzenia wymagań i wskaźników cyberbezpieczeństwa, które będą w stanie reagować na zmiany i, w razie potrzeby, będą na tyle interoperacyjne, że można je będzie przełożyć na inne systemy.

W tym kontekście EMERALD:

- Zapewni narzędzia nowej generacji do gromadzenia materiałów w oparciu o podejście oparte na grafie wiedzy (knowledge graph).
- Zmniejszy złożoność wieloschematowych certyfikatów chmurowych za pomocą wspomaganego mapowania metryk.
- Zapewni audytorom i audytowanym bezproblemową ciągłą obsługę audytu.
- Zapewni interoperacyjność z innymi frameworkami, narzędziami oceny bezpieczeństwa i repozytoriami.
- Zweryfikuje wyniki w pilotażach branżowych (pilots).
- Będzie promował projekt, rozpowszechniał wyniki i koordynował działania z agencjami międzynarodowymi.

Konsorcjum EMERALD, na którego czele stoi Tecnalia (Hiszpania), realizowany jest przez instytucje akademickie w partnerstwie z firmami komercyjnymi specjalizującymi się w takich obszarach, jak certyfikacja w zakresie cyberbezpieczeństwa, przetwarzanie w chmurze, sztuczna inteligencja, projektowanie UX/UI i audyty procesów. Ta różnorodna wiedza specjalistyczna zapewnia solidne podejście do osiągnięcia celów projektu EMERALD, ze szczególnym naciskiem na praktyczne zastosowanie i wczesne przyjęcie wyników. W skład konsorcjum wchodzi 11 organizacji: Tecnalia, Fraunhofer, Fabasoft, Consiglio Nazionale delle Ricerche, Software Competence Center Hagenberg, Know Center, CaixaBank, IONOS, CloudFerro, OpenNebula i Nixu.

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Figure 34. EMERALD Press Release translated into Polish

APPENDIX C Press Releases published by partners

This section contains the press releases published by the individual project partners SCCH⁴⁹ and CaixaBank⁵⁰, respectively. Each release highlights key project developments and milestones, showcasing the dissemination efforts of the consortium.



■ SCCH ■ Softwarepark 32a ■ A-4232 Hagenberg

EU project sets new standards for the certification of cloud services

Hagenberg, DATE: The Software Competence Centre Hagenberg (SCCH) is conducting research with 10 international partners in the EMERALD project (Evidence Management for Continuous Certification as a Service in the Cloud). Funded with 5.5 million euros, the project focuses on the certification of cloud-based services. Many people use Apple iCloud, Google Drive or online banking in their private or professional lives (e.g. time recording or accounting in the cloud). This has led to an increase in the use and acceptance of cloud services. Until now, the certification process for cloud-based services involved many manual activities. These efforts make it difficult to keep pace with rapidly evolving technological advances, but also threats. Due to these limitations, the EU Cybersecurity Act has called for a more flexible approach that includes continuous monitoring and assessment (EU CSA). This more flexible approach allows cloud providers to ensure that their services are constantly compliant with the latest security standards and that they can respond quickly to new threats. This helps to improve the overall security of cloud services and increase user confidence. This is where EMERALD comes in to automate and optimise this process.

When software companies or highly regulated organisations (e.g. banks) want to offer new cloud services they face the challenge of having to fulfil a multitude of security, data protection and regulatory requirements - this is complex and costly. Due to the complexity and dynamics of the requirements, new strategies are needed.

Optimising the certification process

In the EMERALD project, researchers are working on a flexible certification process that supports cloud service providers, customers and auditors throughout the certification process. The aim is to promote the acceptance of cloud services and ensure that they are accessible, secure and useful for all stakeholders. A key objective is to facilitate the path to 'Certification-as-a-Service' (CaaS) using security guidelines. We will provide both cloud service providers and users with a platform to manage and monitor their certifications and enable efficient recertification. In addition, auditors (both internal and external) will be supported. A new concept should help to make the audits simpler and more uniform, making

the certification process less complicated and more flexible," says Dr Somayeh Kargaran, International Cooperations Coordinator at SCCH. As part of the project, cyber security requirements and metrics (e.g. EUCS, BSI C5) are to be created so flexibly that they are interoperable enough to be transferred to other systems if required.

Intelligent queries using knowledge graphs

"At SCCH, we have many years of experience in extracting and analysing knowledge, especially from source code. In the EMERALD project, we use the software analysis platform eKnows that we developed. The certification process involves a lot of different data sources (legal standards, internal company guidelines, process manuals, source code, etc.). In order to integrate and analyse the individual data sources, we need a knowledge graph. Put simply, it is an intelligent network that links and organises information. This enables complex relationships to be better understood," explains Dr Verena Geist, who is leading the project at SCCH. The graph is intended to link evidence from different data sources. In the case of EMERALD, tools for extracting evidence include

- eKnows for language-independent analyses of source code, which is controlled by SCCH,
- Codyze, a code analysis tool for generating evidence for security-relevant findings from Fraunhofer, and
- AMOE, a tool from Fabasoft that analyses company policy documents using natural language processing (NLP).

The researchers at SCCH are responsible for developing the structure of the knowledge graph. "These are critical considerations regarding data storage, structure, and management. Until now, evidence extracted from the analyzed source code has not been linked with other data sources – this is new," says Geist. She explains the specific tasks in the project as follows: "First, the structure of the graph is defined to store and link relevant information. Then, eKnows is used as a tool for static code analysis to extract evidence from the source code. Finally, the information stored in the graph will be used to gain new, more precise insights into the security of the cloud system by correctly piecing together the 'collected puzzle pieces.'"

International project partners

The EMERALD consortium, led by Tecnalia (Spain), consists of a balanced group of academic and industrial partners specializing in areas such as cybersecurity certification, cloud computing, AI, UX/UI design, and audit processes. The consortium includes 11 organizations: Tecnalia, Fraunhofer, Fabasoft, Consiglio Nazionale delle Ricerche, Software Competence Center Hagenberg, Know Center, CaixaBank, IONOS, CloudFerro, OpenNebula, and Nixu.

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Further information:

- Platform for Software Analyses eKnows: <https://www.scch.at/project/eKnows>
- Emerald project: <https://www.emerald-he.eu>

Images (all images © SCCH)

- Project team at the first meeting in Bilbao (from left to right) Stefan Schöberl, Somayeh Kargaran und Verena Geist
- Schematic representation of the knowledge graph (Certgraph Ontology)

To certify a cloud system, specialized evidence extractors analyze different areas such as source code and runtime environments. The CertGraph ontology, consisting of the core ontologies "Core" and "Security Feature" as well as four extensions, links this evidence to provide a comprehensive system overview. (<https://www.emerald-he.eu/certgraph-ontology>)

Press contact

Mag. Martina Höller, Software Competence Center Hagenberg GmbH, martina.hoeller@scch.at, +43 50 343 882, www.scch.at

About the Software Competence Center Hagenberg GmbH

The Software Competence Center Hagenberg (SCCH) is an independent research center that has built outstanding expertise in applied research on Data Science and Software Science for over 20 years. This focus enables the successful implementation of projects in the fields of digitalization, Industry 4.0, and Artificial Intelligence. SCCH serves as a bridge between international research and the local economy.

www.scch.at

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Figure 35. Press release published by SCCH

⁴⁹<https://www.scch.at/scch/presse-medien/detail/eu-projekt-setzt-neue-massstaabe-bei-der-zertifizierung-von-cloud-services>

⁵⁰<https://www.caixabank.com/en/headlines/news/caixabank-is-taking-part-in-a-european-consortium-to-define-a-framework-for-assessing-and-certifying-cloud-services>

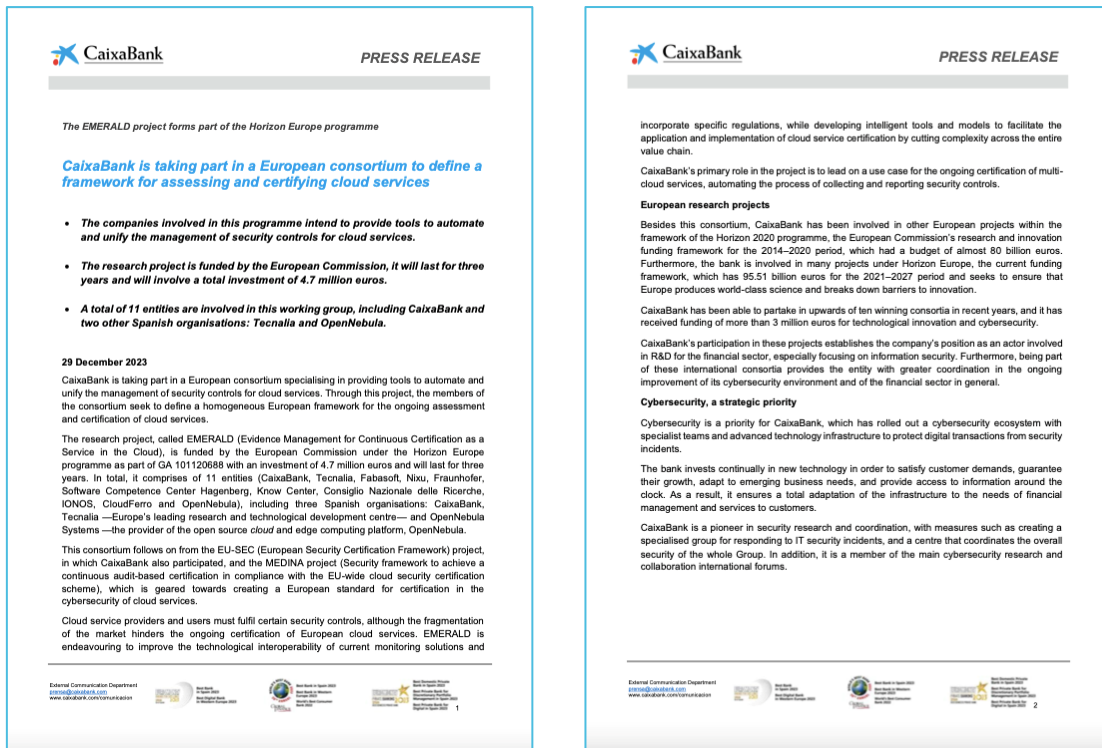


Figure 36. Press release published by CaixaBank

APPENDIX D EMERALD News

This appendix reports the content of the first EMERALD annual summary⁵¹.



⁵¹ <https://www.emerald-he.eu/annual-summaries/>

overall structure

To provide complexity reduction, the work has been split into seven Work Packages (WPs) as shown in Figure 1.

WP1 is building the concept and methodology for the final product, the EMERALD audit suite, utilising the backend components. It closely interacts with the technical parts of WP2 and WP3, and coordinates the implementation of WP4 results. While **WP2 develops the basis for evidence extraction**, **WP3 coordinates the technical development** and sets up tools for continuous integration/deployment and metrics mapping/recommendation. **WP4 develops the concept and implementation of the EMERALD User Interface**. **WP5 is working on providing adequate test pilots** for the EMERALD audit suite resulting from WP1. **WP6 oversees the dissemination and exploitation** of the results developed. Finally, **WP7 handles the project coordination and management**.

The following sections will describe the progress achieved in each work package of the project during the first year.

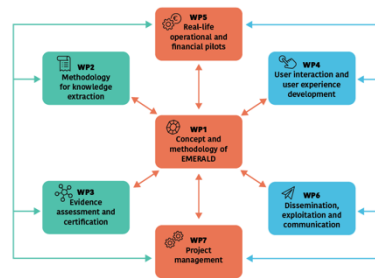


Figure 1: EMERALD Work Packages overview.

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WP1 FRAMEWORK DESIGN AND METHODOLOGICAL BLUEPRINT

The WP1 is in charge of the definition of the **architecture of the EMERALD framework**. This includes the definition of the methodology to be followed by the software developers, the implementation of the required development and integration environments, and the integration of the different components in the EMERALD audit suite.

The project will have **three major releases (in months 18, 30 and 34)**. During this first year of the project, we have **defined a methodology that customizes the DevOps lifecycle**. We have implemented it leveraging DevOps technologies and practices (such as GitLab for source code management, Merge request and automation with GitLab Continuous Integration for early integration; Configuration management for environments using infrastructure as Code with Ansible playbooks to configure a Kubernetes cluster; Container technology to package the components and orchestrate them). All these practices are aimed to **prioritise the speed of integration and provide scalability and resilience to the system**.

Several workshops have been maintained to coordinate the different views that stakeholders have about what the EMERALD framework has to provide and how. As a result, we have defined an **architecture that is composed of 12 components** and detailed the information flows among them (see Figure 2).

Using PlantUML, we have created diagrams (data model, sequence diagram) that specify the behaviour of each component in detail. A glossary is also included, with definitions and examples of crucial terms.

In EMERALD, the requirements elicitation mixes several perspectives, where **Technical, User Interface and Business requirements are gathered independently, and afterwards integrated in a common set**. To this aim, a prioritization and analysis of their relations, status and coverage has been performed. A total of 52

Technical requirements have been elicited in WP1. Then, we have **integrated the different types of data shared between the components and defined a general data model**, which is available on a web page to allow interactive investigation (<https://models.emerald.digital.tecnalia.dev/>).

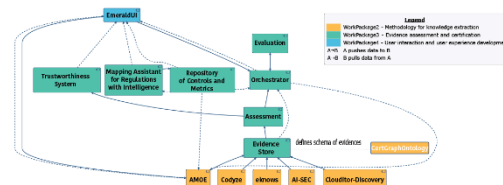


Figure 2: Overview of the EMERALD components.

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WP2 ADVANCED TECHNIQUES FOR EVIDENCE AND INSIGHT EXTRACTION

The overall goal of WP2 is to **establish a unified view of the cloud service under certification** by extracting and enriching knowledge on different layers of the service and providing suitable evidence for security metrics.

To achieve this goal, WP2 focuses on **designing multiple tools and techniques to extract knowledge from various sources and on defining the structure of an underlying certification graph**. In the first year of EMERALD, we have prepared preliminary prototypes of the following extraction components:

- **Codize**, originally launched in MEDINA, and the newly added **knows evidence extractor**, aim at **identifying critical security-related functionality** such as data encryption, transport encryption, or authentication in source code.
- **AMOE**, the component for organisational evidence gathering from MEDINA, analyses various documents and policies of the cloud service provider and **produces evidence about compliance with organisational requirements**.
- **AI-SEC**, a newly developed component, **analyses Machine Learning models for several fundamental evidence** regarding robustness against adversarial attacks, explainability, and fairness.
- **Clouditor-Discovery**, also originated from MEDINA, **collects evidence about the secure configuration of cloud resources, with a novel focus on runtime data extraction**. It is accompanied by Codize-Provenance, a new tool for **gathering evidence about CI/CD pipeline executions**.

Another key result of WP2 is the development of a concept for a unified graph model, i.e., the **schema for storing heterogeneous evidence in a knowledge graph**. As shown in Figure 3, this CertGraph Ontology consists of multiple sub-ontologies, e.g. for modelling security features, and extensions, which cover the individual aspects of extracted evidence. CertGraph Ontology facilitates a higher-level analysis of heterogeneous evidence

since it **enables the combination of various types of evidence into a unified perspective**. This higher-level view helps in querying certification evidence, making it easier to retrieve and analyse relevant information. Additionally, it **serves as the basis for the evaluation and assessment of metrics**, i.e. it provides a structured way to assess and compare different aspects of the certification evidence.

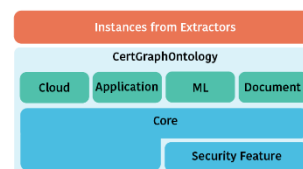


Figure 3: Modular design of the CertGraph Ontology with the extensions in green

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WP3 AUTOMATED ASSESSMENT AND CERTIFICATION FRAMEWORK

The main objective of WP3 is to enable continuous certification decisions based on a certification target constantly changing over time, thus it serves as an **integration point for the evidence collection and knowledge extraction tools of WP2**. The central component is the Orchestrator, which provides the current state of the so-called certification graph.

Due to the complexity of the objective, the activities of this WP have been split into several tasks, each addressing different aspects of certification and compliance. The following is an overview of the tasks and their progress within the first year of the project.

- **Graph-based Representation of Cloud Service Evidence**. This task **integrates the concept of the certification graph as defined in WP2 into the Orchestrator**. We have examined over 40 different graph database implementations that could be used within the EMERALD scope. We are currently testing the most promising one, namely Dgraph, as well as a non-graph database adapted for EMERALD. Moreover, we have performed an initial workshop to define metrics that will be used in EMERALD.
- **Repository of Controls and Metrics**. This task will produce a **smart catalogue of Controls and Metrics** for EMERALD. We have modified the internal schema of the repository used in MEDINA to be more flexible and have adapted it to EMERALD. In this way, the repository will **support other schemas** apart from

EUCS. Furthermore, we have analyzed the OSCAL standard and defined a draft schema for EUCS. In addition, **import/export and mapping functionalities** have been determined to ensure flexibility and interoperability.

- **Metric Selection and Optimization for Cloud Certifications**. The goal of this task is to provide an intelligent system that can **select an optimal set of metrics to be associated with one or more-certification scheme(s)**. Compared to MEDINA's predecessor Metric Recommender, in the novel Mapping Assistant for Regulation with Intelligence (MARI) tool we have developed a new prototype, based on sentence transformers. MARI's performance has already improved over its predecessor. Moreover, the tool is now **able to associate controls from different certification schemes**.
- **Evaluation and Assessment of Metrics based on the Knowledge Graph**. Based on the metrics selected by the MARI and the integration performed in the Orchestrator, this task will **integrate (pre-existing) assessment and evaluation tools** into the EMERALD framework.
- **Blockchain-based Trust System for Auditors**. This task aims at improving the MEDINA TrustWorthiness System (TWS), which explored techniques to maintain the trustworthiness of evidence during its whole lifecycle, thanks to the use of blockchains. In this regard, we have analyzed different options for Blockchain ecosystems to deploy the TWS. Our initial option was EBSI, for which we have submitted an early-adopter request. However, it was not possible to proceed further in the adoption process. Consequently, we have decided to consider the Alastria ecosystem, which we are currently working on. We have also been working on how to adapt the TWS to the EMERALD ecosystem, especially to the EMERALD UI.

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WP4

USER-CENTERED INTERFACE DESIGN AND IMPLEMENTATION

The overall goal of WP4 is to **develop an integrated EMERALD User Interface** which is tailored to the users' needs during all stages of an audit.

To achieve this goal, WP4 is proceeding along 4 streams.

Requirements engineering with compliance managers and auditors. In the first year of EMERALD, we have conducted a set of interviews and focus groups with our target groups (auditors, compliance managers etc.) from the different pilot partners, to **understand their working tasks in relation to preparing and conducting audits**. As a result, so far, we have elicited a set of 23 requirements for UI/UX development.

Modelling work processes. For developing the work processes, we have developed a **set of 7 personas that represent the target users of EMERALD**. For each of them, we have developed scenarios and user journeys to better understand the users' tasks and to develop the interaction concept of how the different personas would use the EMERALD UI. An overview of the EMERALD personas can be seen in Figure 4. Additionally, we were able to derive the first work processes.

Designing a user interaction and user experience concept. With the insights gained from the previous activities, we have developed a **first set of paper-based mock-ups, followed by clickable mock-ups**. The clickable mock-ups are created in a co-creation and co-design process, where we iteratively discuss and improve with the pilot partners and

component owners the respective functionality and UI design. The developed clickable mock-ups look as follows as presented in Figure 5.

Implementation of EMERALD UI. The implementation of the **first prototype of the EMERALD UI** has started. The UI will be based on NextJS and React, utilizing Keycloak for access management. The user interaction concepts and mock-ups previously designed speed up the development process. While some functional details remain to be implemented and integration in the EMERALD framework is to be done, first tests can be made in local instances to get a feeling of how the EMERALD UI will look like and how the user interactions will be presented.

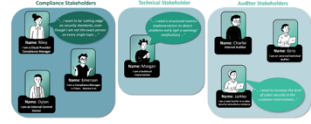


Figure 4. EMERALD Personas and some statements of what they would like to do.



Figure 5. EMERALD UI in the clickable Mock-up.

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WP5

PILOT DEPLOYMENTS AND FRAMEWORK VALIDATION STRATEGY

The goal of WP5 is to **demonstrate how EMERALD can manage and monitor the certification of cloud services according to the needs of the different pilot scenarios**. To this aim, in the business-driven requirements, Key Performance Indicators (KPIs) and goals for four pilots were summarized and aligned with the EMERALD components.

Pilots are divided into two categories: a) certification of **public cloud services** (Pilot 1-3); b) certification of **hybrid cloud-edge environments for the financial sector** (Pilot 4). Figure 6 depicts one of the pilot workflows, displaying the different roles and communication within EMERALD.

In the first year, a **validation plan was developed to provide iterative feedback to the technical WPs**. This plan includes a so-called stage-gate process, for checking the validity of the developed tools and to provide feedback to the EMERALD components. This ensures the project can be adjusted to the needs of the different stakeholders.

Discussions and demo sessions with the technical partners allow the pilots to derive a **personalized, yet scalable scenario for continuous cloud certification processes**. Data exchange and refinement of the evidence extraction tools are an ongoing process.

Pilots and component owners are working on **the creation of metrics to address different controls and security requirements from security schemes** like the EUCS. These metrics will facilitate the evidence extraction and allow for the integration of pilot-specific audit goals.

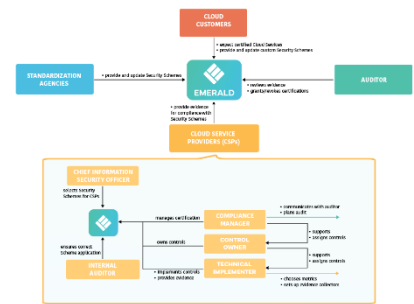


Figure 6. Pilots' workflow.

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WP6

IMPACT OPTIMIZATION THROUGH TARGETED STAKEHOLDER COLLABORATION

The main focus of WP6 is to **maximize the project's visibility and to ensure its outcomes have a lasting impact**, through a structured approach to dissemination, communication, and exploitation.

During the first year, we have defined a **dissemination and communication strategy** to create awareness within cybersecurity and cloud certification communities. Key communication channels, including the EMERALD website (see Figure 7), newsletters, and social media (X, LinkedIn, YouTube), have been launched, providing updates and resources to stakeholders. Additionally, **presentations at major conferences** have contributed to designating EMERALD as a point of reference in cybersecurity certification.

The plan has been designed to target key potential adopters and collaborators across industry and academia. Moreover, it prioritizes **partnerships with other European projects** in cybersecurity and cloud technologies, laying the foundation for future collaborations and aligning with EU policy and innovation goals. Such synergies allow EMERALD to expand its knowledge network and leverage complementary expertise from initiatives with shared objectives, enhancing both resource efficiency and outreach.

For sustainable impact, WP6 has initiated an **extensive market analysis to align project outputs with industry needs, regulatory developments, and technology trends**. Early exploitation plans include exploring commercial paths, such as licensing and certification services based on EMERALD tools. Parallel to this, WP6 aims to ensure **compliance with recognized standards** to increase acceptance within established frameworks. Partnerships with standardization bodies, such as the European Telecommunications Standards Institute (ETSI), provide a pathway for aligning EMERALD outputs with widely recognized standards, facilitating smoother adoption.

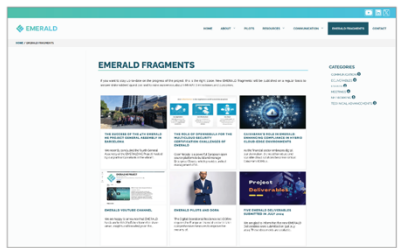


Figure 7. Screenshot of the website

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WP7

EFFICIENT MANAGEMENT AND DELIVERABLE TRACKING

WP7 focuses on providing structured project management to **ensure EMERALD progresses smoothly, adhering to timeline, budget, and quality standards** (see Figure 8). Through WP7, the consortium has established robust coordination mechanisms and reporting tools, fostering effective collaboration across all partners and WPs.

In its first year, WP7 established **essential project structures**, including regular follow-up meetings, document-sharing on the Fabasoft Cloud, and efficient digital communication tools. Tecnalia, who is leading this WP, has organized two **General Assemblies** and **monthly teleconferences to monitor progress and coordinate activities**, addressing emerging issues and promoting transparency. A key milestone was the completion of the Consortium Agreement, securing a formal framework for partner collaboration.

To maintain quality, WP7 set up a **comprehensive Project Manual and Quality Plan** that standardizes templates, review protocols, and quality roles across the project. Tecnalia's risk management structure, including a risk registry, **facilitates early issue detection and timely intervention**. The first months also saw the rollout of an **Innovation Management Plan**, coordinated with input from the External Advisory Board (EAB), whose members provide external oversight to ensure that EMERALD's innovations align with industry and technical standards.

Data management and privacy are also priorities in WP7, with a **GDPR-compliant Data Management Plan**, setting **standards for data collection, storage, and ethical handling**.

Moving forward, WP7 will sustain its oversight of timely deliverables and continue **fostering collaboration across partners**. The next phase will refine data management practices, ensure quality review for upcoming deliverables, and engage more actively with the Security Advisory Board (SAB) and EAB for additional expert guidance and validation.

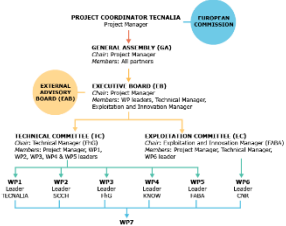


Figure 8. EMERALD management structure.

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what's next

In its first year, EMERALD has laid a solid foundation toward developing a Certification-as-a-Service (CaaS) solution that supports the complex cybersecurity needs of cloud and hybrid cloud-edge environments. Building on MEDINA's successes, the project has combined diverse expertise across eleven partners to advance key technical, methodological, and managerial elements, setting up a cohesive and responsive certification framework. Early achievements include the establishment of CertGraph Ontology, the launch of innovative certification tools, and successful initial pilots that validate the system's potential impact. EMERALD's dissemination efforts have also positioned it as a key player in cybersecurity certification, engaging with standardization bodies and building a pathway for long-term impact.

Looking ahead, the EMERALD team will focus on achieving the first integrated solution released in April 2025, with ongoing enhancements in evidence management, metric optimization, and UI/UX alignment. This phase will include refining the underlying architecture to ensure seamless data flow and integration across different components, enhancing both efficiency and security. Through further pilot validation, EMERALD will improve its certification processes based on real-world feedback, solidifying its functionality and usability. Sustainability and market alignment will also be top priorities, as the project explores paths for industry adoption and compliance with recognized standards. With careful project management and quality assurance, EMERALD is on track to deliver a scalable, user-friendly CaaS platform that meets modern cybersecurity demands.

tecnalia
Fraunhofer
Fabasoft
OpenNebula
CloudKube
IONOS
CloudFlare
Open Nebula
nixu

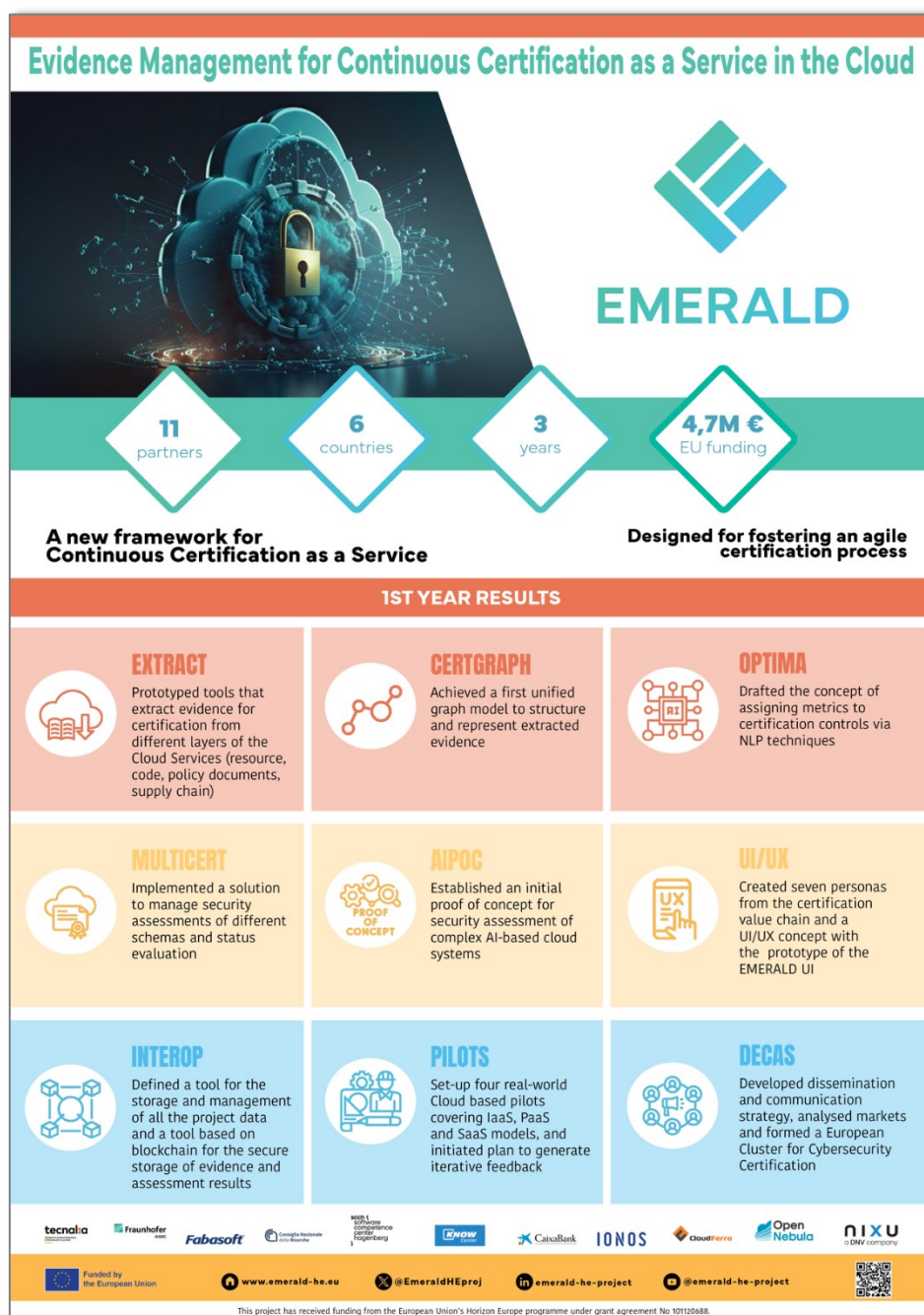
Funded by the European Union

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Last updated 31 October 2024

APPENDIX E Posters

This section provides an overview of the posters produced during the project. The first poster⁵² summarizes the results achieved during the first year of the project and has been distributed through online channels. The second poster⁵³ is about presenting the EMERALD project at the *12th Conference of the European Union's Framework Programme for Research and Innovation* in Spain, titled "Beyond Horizon."



⁵² https://www.emerald-he.eu/wp-content/uploads/2024/12/2024_11_21_poster_results.pdf

⁵³ <https://www.emerald-he.eu/wp-content/uploads/2024/12/emeraldHE-OVIEDO.pdf>



APPENDIX F Presentation

This appendix reports the EMERALD general presentation.



EMERALD EU Project

Evidence Management for Continuous Certification as a Service in the Cloud

This project has received funding from the European Union's Horizon Europe programme under grant agreement No 101120688

EMERALD Innovation Action

- Call: HORIZON-CL3-2022-CS-01
- Start date: 1st November 2023
- End date: 31st October 2026
- Budget: 5,498,900 €



Partners: tecnalia, Fraunhofer AISE, Fabasoft, scch, know center, Cloudferro, Open Nebula, NIXU, IONOS, Cloudferro, Open Nebula, NIXU, IONOS

Mission

- EMERALD leverages the findings of the well esteemed H2020 project MEDINA (GA 952633), starting from TRL 5 in summer 2023 and advances them in the EMERALD Core to TRL 7.
- EMERALD will focus on evidence management components for the continuous certification approach.
- EMERALD will provide a proof of concept (PoC) for mapping the findings to future Artificial Intelligence (AI) certification schemes.





AI Services
AI Cloud Service Compliance
Criteria Catalogue (AIACA)
Disubated
Digital-Sicher-BIS

Overall objective

The overall objective of EMERALD is to pave the road towards **Certification-as-a-Service (CaaS)** for continuous certification of harmonized cybersecurity schemes, like the European Cybersecurity Certification Scheme for Cloud Services (EUCS).

EMERALD will significantly decrease the time needed to re-certify, select and evaluate new cloud-based services and to facilitate the integration of new services that are not on premise but offered by different and also smaller providers.

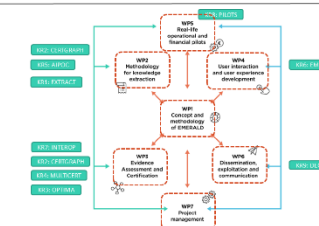
Target users

Stakeholder groups of the cybersecurity domain: cloud service providers, cloud customers, auditors, and standardization agencies.

- **Cloud service providers and Cloud customers:** EMERALD will offer a framework to set-up, manage and monitor their certifications and enable lean re-certification.
- **Auditors:** EMERALD will offer an audit assistance framework to address audits in a uniform manner and reduce complexity by customizing the audit process.
- **Cybersecurity and standardization agencies:** EMERALD will provide novel strategies and methods for building cybersecurity requirements and metrics that can react to changes and, if necessary, are interoperable enough to be translated to other schemes.



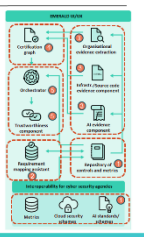
Work Packages



WP1: Requirements and Architecture
WP2: Knowledge Extraction
WP3: Concept and Implementation of EMERALD
WP4: Evidence Assessment and Certification
WP5: Dissemination, exploitation and communication
WP6: Project Management

Approach

1. Different controls from one or more certification schemes are selected, which are a comprehensive set of rules, technical requirements, standards and procedures with which to demonstrate compliance.
2. An intelligent system selects an optimized set of metrics that can be measured to demonstrate compliance with the controls.
3. Several components continuously extract knowledge on various layers of the cloud service (infrastructure, code, policies and procedures, AI models) and prepare suitable evidence based on them.
4. A graph-based structure (the certification graph) consolidates all necessary information about the service uniformly and makes it ready for queries.
5. The audit suite assesses and evaluates chosen metrics based on information provided by the certification graph during the whole lifecycle of the cloud service.



Objectives

- Provide next-generation evidence gathering tools based on a knowledge graph approach
- Reduce complexity in multi-scheme Cloud certifications by assisted metric mapping
- Provide a seamless user experience of continuous auditing for auditors and auditees
- Provide interoperability to other frameworks, security assessment tools and repositories
- Validate the outcomes in industrial pilots
- Promote the project, disseminate results and coordinate with international agencies

Objectives and Key Results

1. Provide next-generation evidence gathering tools based on a knowledge graph approach
 - **KR1 EXTRACT: Evidence extraction from cloud service**
A framework to continuously extract knowledge on various layers of the cloud service (infrastructure, code, business processes) and prepare suitable evidence based on them.
 - **KR2 CERTGRAPH: Certification graph**
A graph-based structure to consolidate all necessary information of the service and to make it easily query-able, linking heterogeneous information extracted from different evidence sources.

Objectives and Key Results

2. Reduce complexity in multi-scheme Cloud certifications by assisted metric mapping
 - **KR3 OPTIMA: Optimized metric selection**
An intelligent system to select an optimized set of metrics that can be measured to demonstrate compliance to the selected certification scheme.
 - **KR4 MULTICERT: Cloud certifications**
A tool to assess chosen metrics based on information stored in the certification graph and to evaluate the final certificate decision.
 - **KR5 AIPOC: Proof of Concept for AI-based certifications**
A proof of concept (PoC) on how to scale the CaaS approach to cloud-based AI systems.

Objectives and Key Results

3 Provide a seamless user experience of continuous auditing for auditors and auditees

KR6 EMERALD UI/UX: User experience for complexity reduction
A user interaction concept and conducted studies to show what information each user needs in an audit process.



EMERALD - 101120688

Objectives and Key Results

4 Provide interoperability to other frameworks, security assessment tools and repositories

KR7 INTEROP: Interoperable assessment, evidence and catalogue data
EMERALD will provide an interoperability layer among the trustworthy systems, assessment results and catalogue data. Standardized formats such as OSCAL (Open Security Controls Assessment Language) will be used to mitigate the impact of changes in the security schemes.



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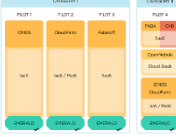
Objectives and Key Results

5 Validate the project outcomes in industrial pilots

KRB PILOTS: Industrial pilots
Involvement of realistic use cases by potential applicants of EMERALD.

Category I: Certification of public Cloud Services (IaaS, PaaS, SaaS)

Category II: Certification of hybrid cloud-edge environments for the financial sector



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Objectives and Key Results

6 Promote the project, disseminate results and coordinate with international agencies

KR9 DECAS: Dissemination, exploitation, communication and standardization
The project results will be disseminated via multiple channels, relevant conferences and the scientific community. Project findings will be discussed with standardization bodies.



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Building blocks

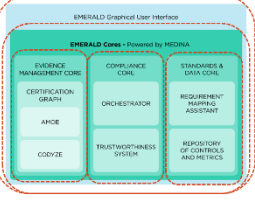
EMERALD GUI: harmonized interface, offering a human centered application

EMERALD CORES: manage heterogeneity and provides abstraction

EVIDENCE MANAGEMENT CORE: abstracts evidence from components through an Evidence Graph

COMPLIANCE CORE: assessment and evaluation of chosen metrics

STANDARDS & DATA CORE: integration of the security scheme and standards data as well as the metrics



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In a nutshell

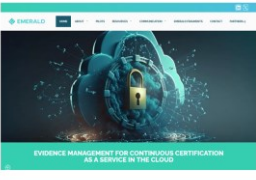
EMERALD will enhance the user experience of continuous auditing for auditors and auditees through a CaaS process, supported by user-tailored tools for complexity reduction in multi-scheme cloud certifications, including next-generation evidence gathering tools based on a knowledge graph approach and assisted metric mapping tools.

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More information

Further details are available at

- EMERALD website
www.emerald-he.eu
- X
[@EmeraldHEproj](https://twitter.com/EmeraldHEproj)
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[emerald-he-project](https://www.linkedin.com/company/emerald-he-project)



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