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D6.3 - Final report on impact activities

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Executive Summary

During the second period of the aerOS project (M19–M38), impact creation activities reached full maturity, consolidating the results achieved during the first phase and demonstrating measurable progress across all Key Performance Indicators (KPIs). The activities under Work Package 6 (WP6) effectively ensured the communication, dissemination, standardisation, and exploitation of aerOS outcomes, maximising their visibility, uptake, and long-term sustainability.

The aerOS project reached full maturity in its impact-related activities during the second reporting period (M17–M38). Significant progress was made across all Key Performance Indicators (KPIs) related to communication, dissemination, standardisation, exploitation and innovation. The project successfully strengthened its European presence, contributed to international standardisation bodies, and laid down a comprehensive exploitation framework to ensure sustainability and commercial impact.

All (traceable^{*1}) impact KPIs were achieved or exceeded by Month 38, confirming the effectiveness of the project’s communication, dissemination, standardisation and exploitation strategies. In this second period (M19 to M38, i.e., March 2024 to October 2025), major growth was observed in (a) Outreach and visibility through online platforms, (b) Scientific publications including academic activities and (c) Exploitation activities, including delivery of an OSS product (ECLIPSE) and Joint Exploitation plans of aerOS 5 pilots.

Communication efforts intensified through coordinated use of the project website, social-media channels, newsletters, and press releases, achieving a sustained increase in outreach and engagement. The project maintained a strong online presence and enhanced its visibility within the European research and innovation landscape, particularly through active participation in EUCloudEdgeIoT and related ecosystem initiatives.

Here social media remained very active in the second period, with YouTube channel standing out (a total of 51 videos) apart from periodic newsletter, relevant articles and press releases and some special campaigns such as the one devoted to Open Call #2.

Dissemination activities expanded the project’s scientific and industrial footprint through high-quality publications, conference presentations, and public events. Project showcasing and demonstration activities provided practical evidence of aerOS technologies in action, highlighting their relevance to diverse industrial domains represented by the five pilots. In particular, high-impact journals and conference papers, industrial and academic showcases (highlighting IoT Tech Expo 2025 in Amsterdam), workshops, PhD and other relevant activities.

In the domain of standardisation, one achievement stars out: the championing by aerOS of the orchestration block in the architecture of TF3, that is incorporated in the current Preliminary Working Item ISO/IEC SC41/JTC1. This achievement has been reinforced by the presence of Lara Lopez (ATOS) in aerOS final event. On another note, aerOS contributed significantly to relevant Standard Development Organisations (SDOs) and pre-standardisation bodies, such as ETSI, AIOTI, 5G-ACIA, and IETF, strengthening Europe’s leadership in the edge-cloud continuum. These contributions reinforced the project’s alignment with the broader Cloud-Edge-IoT (CEI) strategy promoted by the European Commission.

Exploitation and innovation activities followed a 4-phaser Innovation Roadmap during M19-M38, that culminated in the identification and refinement of Key Exploitable Results (KERs), updated business models, and joint exploitation strategies for all pilot use cases. The deliverable also presents market and competitiveness analyses, showcasing how aerOS outcomes can be capitalised upon by industrial and academic partners beyond the project’s lifetimes. Activities in this regard include the detailing (and analysis of) Background IP, Foreground OP, Exploitable Results and key Exploitable Results, departing from the declaration of 10 innovation elements to the Innovation Radar initiative back at M18 (February 2024). An IPR Matrix has been produced to record patents, software, trademarks, ownership, and protection status to govern exploitation transparently.

Four KERs have been finally identified (KER1 MetaOS Runtime managing distributed Infrastructure Elements and coordination services; KER2 -Two-level Orchestration Stack: High-Level Orchestrator (HLO) and Low-Level Orchestrator (LLO); KER3 Data Fabric with “Data as a product” methodology, context broker, and NGSI-

¹ Note that some impacts listed in the DoA refer to the potentialities of aerOS impact beyond the duration of the project, therefore they cannot be measured at this stage.

LD extensions and KER4 -DevPrivSec CI/CD methodology and cloud-native deployment tools.). In this regard, individual exploitation plans of partners have been detailed, divided in partner types (academia, SMEs, large industries..) that have contributed to such KERs and ERs.

The other relevant action performed in T6.4 has been the delivery of in-depth Joint Exploitation Plans of the 5 pilots of the projects, where the partners involved in every use case collaborated to perform activities along the duration of the action and also beyond.

In this regard, some relevant conclusions from Pilot 1 (manufacturing) were. (1) to focus on sustainability with real-time CO₂ tracking, digital product passports, and predictive analytics, (2) that a TRL 7 was achieved thanks to aerOS modularity, and (3) that aerOS has helped to gain a competitive advantage thanks to the prototyping structure and validating innovative models over heterogeneous computing continuum.

Pilot 2 accessed new commercial direct actions and established a line for edge-cloud orchestration in containerized edge data centers integrated with renewable energy for sustainability. Industrial deployments (together with ELECTRUM energy locations) has allowed to demonstrate that large workloads of the business of earth observation can be handled thanks to aerOS, which might open relevant market possibilities.

Pilot 3 has already exploited an aerOS-direct outcome, the HPCP computing hardware platform from TTC over real electric (and fuel-based tractors), reducing CO₂ and applying predictive maintenance and AI models (e.g., computer vision) in actual (seasonal) agricultural operations. Exploitation here for the partners will root in modular, vendor-agnostic IoT infrastructure and a potential market adoption focused on large-scale farms and OEMs.

Pilot 4 has discovered (and already validated) sound exploitation routes in predictive maintenance and AI-driven computer vision for container inspection. SME service provider (PRO), academic expertise (CUT) and large industry stakeholder (EGCTL) together have paved the way for market expansion of aerOS Meta OS in logistics field.

Lastly, pilot 5 has highlighted how aerOS can be exploited for handling in a distributed matter very innovative aspects in safer and healthier buildings, such as AI-controlled HVAC, occupancy optimization, environmental monitoring. Here, the target would be target large enterprises, real estate developers, and urban planners.

All the remarks above have been found after thorough analysis of the exploitable outcomes of each pilot, and the application of specific tools such as Lean Canvas, SWOT Analysis, Porter's Five Forces model, LLava matrix among others.

A flagship exploitation action is the Eclipse aerOS initiative, which transfers core aerOS assets into a community-governed, open-source Meta-OS under the Eclipse Foundation to ensure post-project sustainability and broad adoption

As an exploitation reflection, aerOS has established a mature, measurable impact across communication, dissemination, standardisation and exploitation. From continuation perspective, the creation of an open source product (ECLIPSE aerOS) guarantees the sustainability of the Meta OS technology, allowing it to be positioned as a strategic European platform for the cloud-edge-IoT continuum. The fact of entailing to ECLIPSE aerOS a **hybrid open-source business model**, combined with community-driven governance under Eclipse Foundation, ensures long-term sustainability and adoption. • aerOS aligns with EU strategic policies on digital sovereignty, interoperability, sustainability, and vendor-neutral infrastructure Continued innovation, cross-sector exploitation, and market expansion are planned to maximize industrial competitiveness and environmental impact.

Overall, D6.3 demonstrates that aerOS has achieved its objectives for impact generation, fostering a sustainable ecosystem and laying the foundations for continued collaboration, standardisation influence, and commercial exploitation after the end of the project.

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List of acronyms

Acronym	Explanation
3GPP	3rd Generation Partnership Project
5G	5th Generation
5G IA	5G Infrastructure Association
5G PPP	5G Public-Private Partnership
AI	Artificial Intelligence
AIOTI	Alliance for Internet of Things Innovation
ANSI/ISA	American National Standards Institute / International Society of Automation
BDVA	Big Data Value Association
CA	Consortium Agreement
CIS	Controls IoT Security
cPPP	contractual Public-Private Partnership
CSA	Coordination and Support Action
DLT	Distributed Ledger Technology
DoA	Description of Action
Dx.y	Deliverable No y of Work Package x
EC	European Commission
ENI	Experiential Networked Intelligence
ENISA	European Union Agency for Cybersecurity
ESCO	European Cyber Security Organisation
ETSI	European Telecommunications Standards Institute
FIWARE	Future Internet open-source platform
GA	General Assembly
GSMA	Global System for Mobile Communications
IEEE	Institute of Electrical and Electronics Engineers
IEEE SA	Institute of Electrical and Electronics Engineers Standards Association
IEC	International Electrotechnical Commission
IETF	Internet Engineering Task Force
IIRA	Industrial Internet Reference Architecture
IoT	Internet of Things
IRTF	Internet Research Task Force
ISG	Industry Specification Group
IT	Information Technology
ISO	International Organization for Standardisation
ITU-T	International Telecommunication Union Telecommunication

KPI	Key Performance Indicator
KVI	Key Validation Indicator
MEC	Multi-access Edge Computing
ML	Machine Learning
MS	Milestone
MVP	Minimum Viable Product
NGIoT	Next Generation Internet of Things
NFV	Network Function Virtualization
NGO	Non-Governmental Organisation
ONF	Open Networking Foundation
PC	Project Coordinator
PDL	Permissioned Distributed Ledger
PoC	Proof-of-Concept
RA	Reference Architecture
RAN	Radio Access Networks
RTO	Research and Technology Organisations
SAI	Securing Artificial Intelligence
SDN	Software Defined Networks
SDO	Standardisation Organisation
SEDIA	Single Electronic Data Interchange Area
SG	Standardisation Group or Study Group
SP	Special Publication
SRIA	Strategic Research and Innovation Agenda
STF	Standardisation Task Force
Telco	Teleconference
TF	Task Forces
TIC	Terminal Industry Committee
TM	Traffic Management
TSG	Technical Specification Groups
Tx.y	Task No y of Work Package x
W3C	World Wide Web Consortium
WG	Working Group
WPx	Work Package No x

1. About this document

1.1. Deliverable context

This document contains the objectives, plan, and related deliverable that are associated with Impact activities of period M19-M38 according to the project's Description of Action (DoA) Table 1.

Table 1 Deliverable context

Item	Description
Objectives	Obj 7 - Global ecosystem creation, maximisation of impact and Open Call conduction For impact creation, aerOS, results will be presented/promoted within publications, conferences, website, social media, and workshops. Further, several exhibitions/showcases will take place, including small demonstrations, to engage stakeholders and potential clients from diverse verticals, mobilising key actors. Moreover, business models (aligned with use cases technical capabilities, ecosystem, and functionalities) that include market and sustainability strategy, supported by preliminary value proposition and pricing policy, will be proposed, with a starting point in the Cloud Industry Roadmap. The ecosystem building will be supported by two Open Calls, allowing new partners to join the Consortium and develop applications and/or aerOS components. Furthermore, an Advisory Board will be formed, with at least 4 key members from industry and academia. aerOS will track relevant standards bodies to be compliant with, and contribute to convergence of, so far scattered, initiatives throughout Europe (indicatively: DSBA, NGI, AIOTI, BDVA, AI4EU, FIWARE or Gaia-X) to set the basis of a common, open, platform independent meta operating system for the IoT edge-cloud continuum.)
Work plan	This deliverable reports the status and development of the different tasks that belong to Work Package 6 (WP6), that deals with the generation and monitoring of impact. The different tasks are: • T6.1: Communication activities (Lead: INF, Partners: ALL) • T6.2: Dissemination activities, project showcasing and industrial demonstrations (Lead: TTC, Partners: ALL) • T6.3: Standardisation and policies alignment (Lead: SIEMENS, Partners: UPV, NCSR, TTC, FF, TID, IQB, LMI, SRIPAS, ICT-FI, INF, PRO, ECTSL, S21Sec, JD, CF, MADE, SIPBB) • T6.4: Exploitation activities, IPR management, innovation, business, market operations and sustainability (Lead: 8BELLS, Partners: ALL) Representatives of the lead partners of each task have provided the content of this deliverable, describing the period 2 impact performed activities and Impact KPIs. Representatives of 8Bells have acted as editors of this deliverable, and the teams from TID and ICT-FICIAL have performed the internal reviews.
Deliverables	D6.3 builds upon the information provided in D6.2, which in turn verified the implementation of the plans established in D6.1 (Impact Activities Planning). This deliverable provides a comprehensive overview of the impact activities carried out during the second half of the project, evaluating their effectiveness and outlining the final outcomes achieved. In addition, D6.3 complements D5.6 as together these deliverables provide a complete overview of the aerOS KPIs, assessing their final status and measuring the overall impact of the project at its conclusion.

1.2. Impact Key Performance Indicators KPIs in M38

The main objective of this deliverable is to report the details of the development of WP6 tasks in the second of the project and in total for the full project duration. Before those details are reported in sections 2 to 5, Table 2 offers a quick glance into the status of KPIs, with the purpose of providing a good insight into the successful work done so far, the targets achieved at M24 (Year 2 end) and how since then we progressed up to project end (M38).

Table 2 Status of impact KPIs in M38

KPI#	KPI	Task	Target (M38)	Status (M24)	Status (M38)
3.1.1	# of Website unique visitors / page views	T6.1	4000/10000	5,115/20,505	7.147/20.706
3.1.2	# of aerOS posts in social networks/ #of newsletters issued	T6.1	1000/12	736/7	1491/11 (& 1 under editing)
3.1.3	# of aerOS social-media community members across all-sites	T6.1	1000	1,018	2096
3.1.4	# of videos delivered about aerOS technical and global advances / webinars-workshops organised	T6.1	20 / 6	11/15	49/35
3.1.5	# of interviews/articles/press releases with external relevant dissemination targets	T6.1	30	19	30
3.1.6	# of liaison with other projects of the cluster including CSA events	T6.1	35 actions	40	>60
3.2.1	# of scientific papers published in conferences / Q1-Q2 journals	T6.2	20 / 8	5/11	23/24
3.2.2	# of activities towards Education institutions (courses, lectures, PhDs)	T6.2	15	4	18
3.2.3	# of presentations and other activities in events/conferences/fairs by aerOS partners	T6.2	35	39	77
3.2.4	# of workshops organized / average participants in each workshop	T6.2	3 / 60	10/20	18/30
3.2.5	# of PhD and MSc theses started about aerOS	T6.2	6	10	11
3.3.1	# of contributions to SDOs	T6.3	12	18	12
3.3.2	# of entry points to SDOs or pre-normatives exploited	T6.3	25	15	25
3.3.3	# of contributions to European pre-normatives	T6.3	3	2	3
3.3.4	# of contributions to data-related clusters and initiatives	T6.3	10	1	10

3.3.5	# of contributions to relevant data spaces	T6.3	10	2	10
3.4.1	# of contributions to OSS projects	T6.4	12	11	15
3.4.2	# of business plans for exploitable assets, stakeholders and key alliances identified and contacted	T6.4	100,00%	N/A (see footnote) ²	100%
3.4.3	# of new business lines on aerOS by partners	T6.4	2	N/A (see footnote)	2
3.4.4	# of startups adopting aerOS results as technological baseline for business	T6.4	1	N/A (see footnote)	11
3.4.5	# of tech-transfer contracts signed based on aerOS	T6.4	1	N/A (see footnote)	(0) In progress
3.4.6	# of private investments in aerOS and related open technologies	T6.4	10 M€	N/A (see footnote)	(0) In progress
3.4.7	Market share in edge-cloud-computing of Europe vs world	T6.4	32,00%	N/A (see footnote)	~24%

1.3. Deliverable structure

This deliverable is structured into **eight main sections**, reflecting the comprehensive coverage of WP6 activities during the second reporting period:

- **Section 1 – About this Document:** Introduces the deliverable, its objectives, and its relation to other project outputs, including an overview of impact-related KPIs and their final status at M36.
- **Section 2 – Communication Activities:** Summarises the communication results of Task 6.1, including website updates, social-media performance, press and newsletter outputs, and participation in ecosystem initiatives. It also presents cumulative KPI analyses and dashboards.
- **Section 3 – Dissemination Activities, Project Showcasing, and Industrial Demonstrations:** Details the dissemination results achieved by Task 6.2, covering scientific publications, event participation, collaborations, and demonstrations performed across pilots.
- **Section 4 – Standardisation and Policy Alignment:** Reports the outcomes of Task 6.3, describing the project's active role in standardisation bodies, contributions to SDOs, and participation in pre-normative initiatives relevant to the computing continuum.
- **Section 5 – Exploitation, IPR Management, and Innovation:** Covers Task 6.4 results, focusing on exploitation strategies, innovation management, IPR protection, KERs, and sustainability plans.
- **Section 6 – Synergies and Business Analysis (Joint Exploitation Plans):** Presents joint exploitation strategies across the five aerOS pilots, including individual and cross-pilot business models, market analyses, and success metrics.
- **Section 7 – Business Analysis – Eclipse aeriOS:** Explores the business perspectives, synergies, and post-project exploitation potential of aerOS's open-source meta-OS ecosystem.
- **Section 8 – Conclusion:** Summarises the overall impact achievements of WP6 and outlines recommendations for sustaining aerOS results beyond the project duration.

² These KPIs do not have a specified target for M24. All target values are referred to M38. See section 5.1.4 for more info.

2. Communication Activities

Communication in the second period of the project (M19-M37) and status of KPIs

The following sections provide a detailed update on the communication activities performed under the coordination of T6.1 during the period March 2024-September 2025 (M19-M37). Please note that October 2025 activities are still ongoing (at the time of editing D6.3) and will be processed/calculated and added in the existing values during November and presented in total during the final review.

2.1.1. Updates on Channels of Communications

In this section the aerOS communication channels utilised during the period M1-M16 are presented along with the updates that they have undertaken in order to support additional project's activities/initiatives.

2.1.1.1. Website

The aerOS project's website serves as the primary communication channel. It was established during the initial phase of the project, specifically in September 2022 (M1). Accessible at <https://aeros-project.eu/>, the official aerOS website functions as a portal for sharing comprehensive information about the project and its activities. Its primary role is to ensure widespread outreach across diverse industries and engage various stakeholders by providing detailed insights into the project's activities.

The aerOS website reflects the project's unified visual identity and encompasses its activities and accomplishments. Simultaneously, it serves as a platform for both internal and external audiences to explore the project's methodology, goals, structure, case studies, latest updates, upcoming events, ongoing activities, and key contact information for the consortium's coordination team.

For stakeholders interested in the project, the website serves also as a “business portal” for information, actions and impact creation. The website is focused on the Consortium's shared understanding of the project's scope and objectives, for creating impact through the efficient communication/dissemination of aerOS activities, results and achievements. aerOS website will be live for the entire lifespan of the project and for at least 3 years after its completion.

In detail, the aerOS website is:

- Developed using WordPress by the NCSRD (TM) and INF (WP6 and T6.1 leader) teams and its constantly updated to newer versions/releases,
- Domain name owned and hosted by the UPV (PC) for 6 years,
- Content constantly maintained and updated by the INF team as T6.1 leader,
- It has multiple menu options-buttons available for covering all types of project's activities,
- Compact and comprehensive webpages for easy navigation,
- It provides contact form, directly addressing the project coordinator, technical manager and WP6 leader,
- Google Analytics enabled and Looker studio used for statistical monitoring and evaluation of performance,
- It denotes in its footer that is part of EUCloudEdgeIoT through the corresponding tag image.

The website succinctly and comprehensively addresses the communication needs of the aerOS project, as the core communication channel, featuring an enhanced menu, well-organized webpages and sections, a lot of downloadable content, a detailed footer and an enriched dissemination menu. In specific, the menu conveniently initially grouped seven easily accessible options: Home, Objectives, Use Cases, Consortium, Dissemination, News, and Contact. Additional to these sections that were placed since the beginning of the project, a new menu option entitled Open Calls is now in place in order to support aerOS Open Call 1 since September 2023 (M13) (Figure 1).;Error! No se encuentra el origen de la referencia.

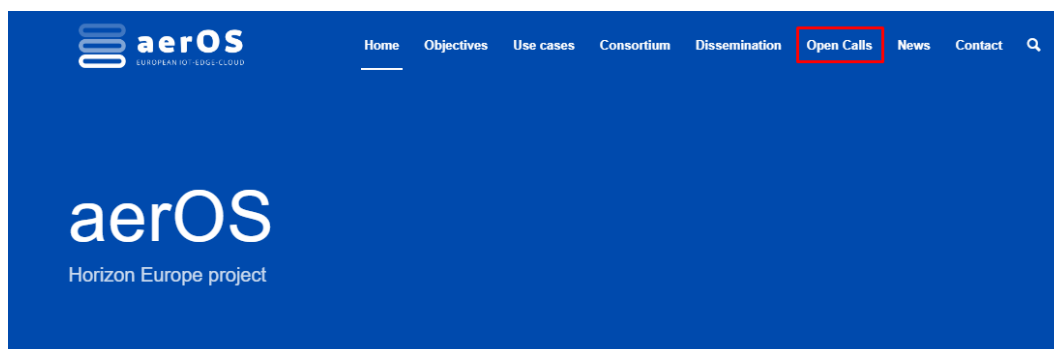


Figure 1 aerOS Open Call menu

This menu was created in order to facilitate the needs related to the Open Call of the project. It is consisted by 2 different sections, the one entitled “Open call #1” and the other “Open Call FAQ”.

The “Open call #1” sub menu provides all the related information about the aerOS 1st Open Call, along with instructions for submission and dedicated material for further downloading. The “Open Call FAQ” sub-menu is also in place since M13. In the Open Call FAQ webpage, any interested stakeholder (potential OC applicant) can find a set of at least 12 frequently asked questions (and continuously updated) along with the equivalent answers. In this Open Calls menu, we will add later (mid 2024) a new sub-menu entitled “Open call #2” when the project will launch its 2nd Open Call (Figure 2).

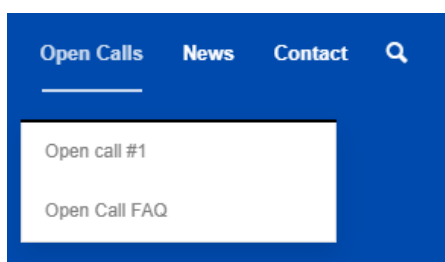


Figure 2 Open Calls Tab Menu

Apart from the Open Call webpage. The website had also two other extremely active pages. The one is news webpage (<https://aeros-project.eu/blog/>) which is updated on a weekly basis. Additional posts are being made in specific occasions such as plenary meetings and dedicated events. The other active webpage is the dissemination one (<https://aeros-project.eu/dissemination/>). There any interested stakeholder can find all the latest dissemination activities in the equivalent sub-sections (Figure 3).

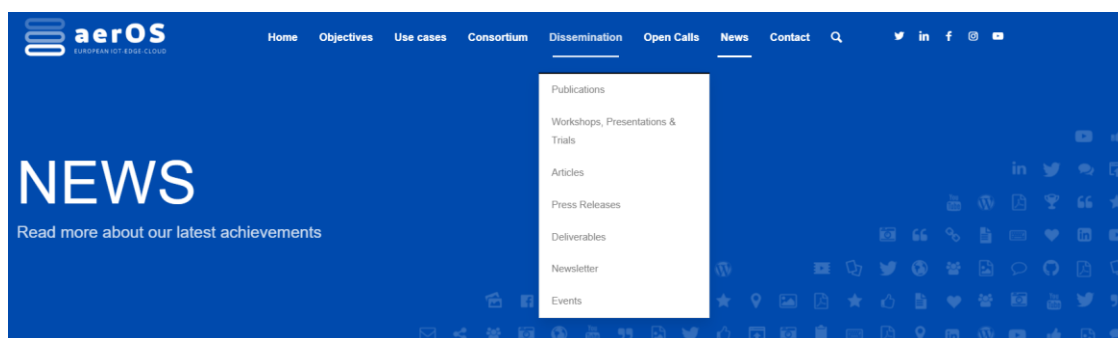


Figure 3 Dissemination Tab Menu

More details on the structure of the website and the details of its webpages was provided in D6.1.

2.1.1.2. Social Media Channels

The social media channels constitute the second key pillar of aerOS communication. Establishing the project's presence across various social media platforms allows us a broad dissemination of the project's impact to diverse audiences in a cost-effective and efficient manner. This approach serves as an ideal means to share knowledge

derived from aerOS achievements and key findings. However, reaching the widest audience needs a strategic management of social media to effectively engage both technical and non-technical audiences **¡Error! No se encuentra el origen de la referencia..**

Outlined below is a provisional list enumerating the benefits of leveraging social media:

- Communication of project news, content, activities, and outcomes,
- Creation of a distinct project identity and branding, reaching a broad and diverse audience,
- Identification of potential new audience segments and stakeholders,
- Sustaining and fostering audience engagement through regular, weekly posts,
- Monitoring the project's impact,
- Establishing connections and affiliations with similar activities/initiatives/actions, projects, communities, and associations (e.g., EU, Horizon Europe, HiPEAC, EUCloudEdgeIoT, 6G-IA/SNS, working groups).

Table 3 Social Media Channels

LinkedIn	https://www.linkedin.com/in/aeros-project/
X (Twitter)	https://twitter.com/AerosProject
Facebook	https://www.facebook.com/aerosproject
Instagram	https://www.instagram.com/aerosproject/
YouTube	https://www.youtube.com/@aeros-project

2.1.1.2.1. LinkedIn Channel

LinkedIn serves as an online business platform where users can establish profiles and connect with others, forming a digital professional network. It is an effective tool for sharing achievements and activities across various industries, contributing to professional branding.

The aerOS project is actively building and expanding its audience on LinkedIn, leveraging connections interested in project-related content. The aerOS LinkedIn bio (<https://www.linkedin.com/in/aeros-project/>) provides concise details about the project, including a brief description, the call, and the number of connections. Additionally, any LinkedIn follower can easily review the account and interact with the shared content (Figure 4).



Figure 4 LinkedIn page

2.1.1.2.2. X (Twitter) Channel

X (former Twitter), a widely used social media platform, serves as a valuable tool for expanding the aerOS network across diverse audiences. The aerOS Twitter account (<https://twitter.com/AerosProject>) provides a brief overview of the project along with details on Followers, Following, etc.

Users can read posts, express their interest by liking, resharing, and commenting, enhancing the project's communication by reaching not only followers but also a broader audience. The concise format and character limitations of X posts allow the project to effectively function as a news portal, enabling followers to access brief updates on project-related activities (Figure 5).



Figure 5 X account

2.1.1.2.3. Facebook Channel

The aerOS project maintains a presence on Facebook at <https://www.facebook.com/aerosproject>. Utilizing Facebook, one of the most widely used social media platforms, proves to be one of the simplest methods for enhancing brand value and expanding social media visibility, especially among the public. On Facebook, aerOS employs a strategy of sharing "more general interest" content.

This approach doesn't mean that the project's technological and innovative content or achievements are excluded; instead, such information is communicated using a non-technical, easily understandable language. Through the Facebook channel, users can stay updated on the project's recent activities, public news, and articles (Figure 6). Engagement is encouraged through various means, including likes, comments, shares, and the encouragement of users and connections to promote the project.

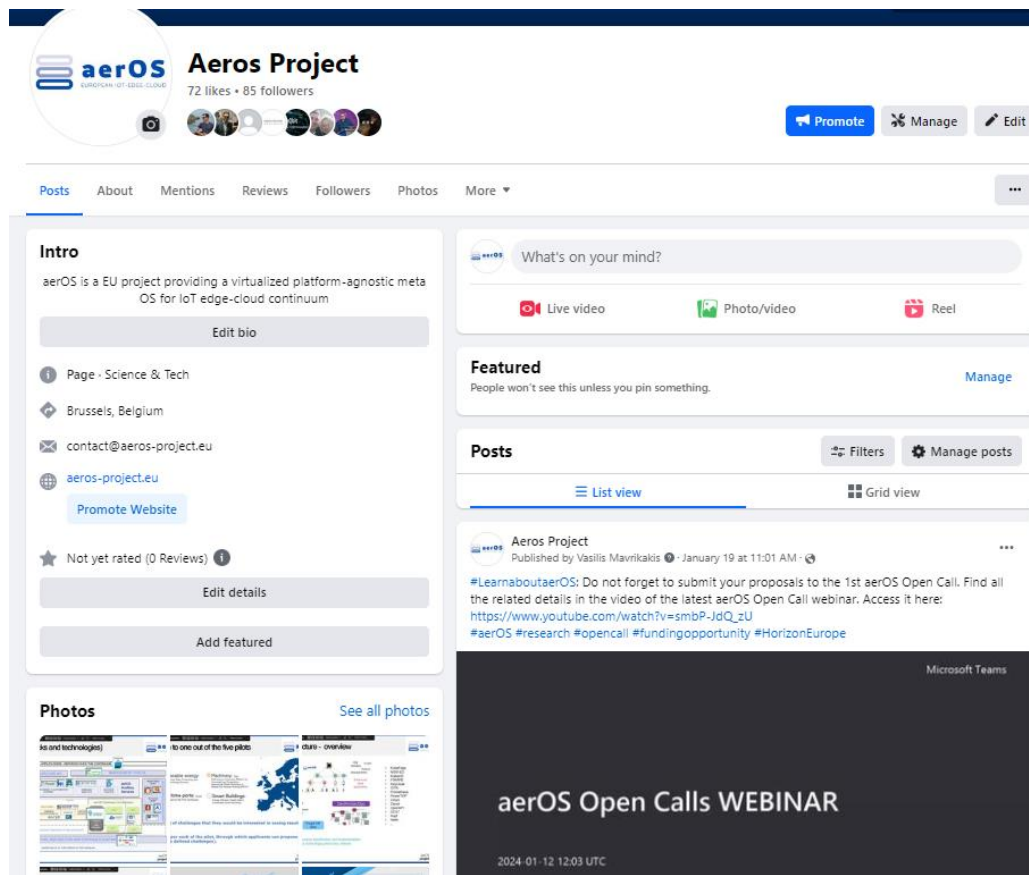


Figure 6 Facebook Account

2.1.1.2.4. Instagram Channel

The aerOS project actively also maintains presence on Instagram at <https://www.instagram.com/aerosproject/>. Instagram, being the most widely used platform for sharing images and videos, is strategically utilized by the aerOS to showcase project activities, achievements, and relevant content. This engagement aims to extend the reach of dissemination and communication efforts to new audiences. Leveraging the platform's emphasis on visual components, such as images and videos, allows for a more visually appealing and concise presentation of project-related information.

The communication strategy for Instagram involves incorporating less technical text, enriched with photos, to convey project content in a more accessible and visual manner. The Instagram account bio provides users with project information and a link to the website (or any regularly posted related activity link) for easy access (Figure 7).

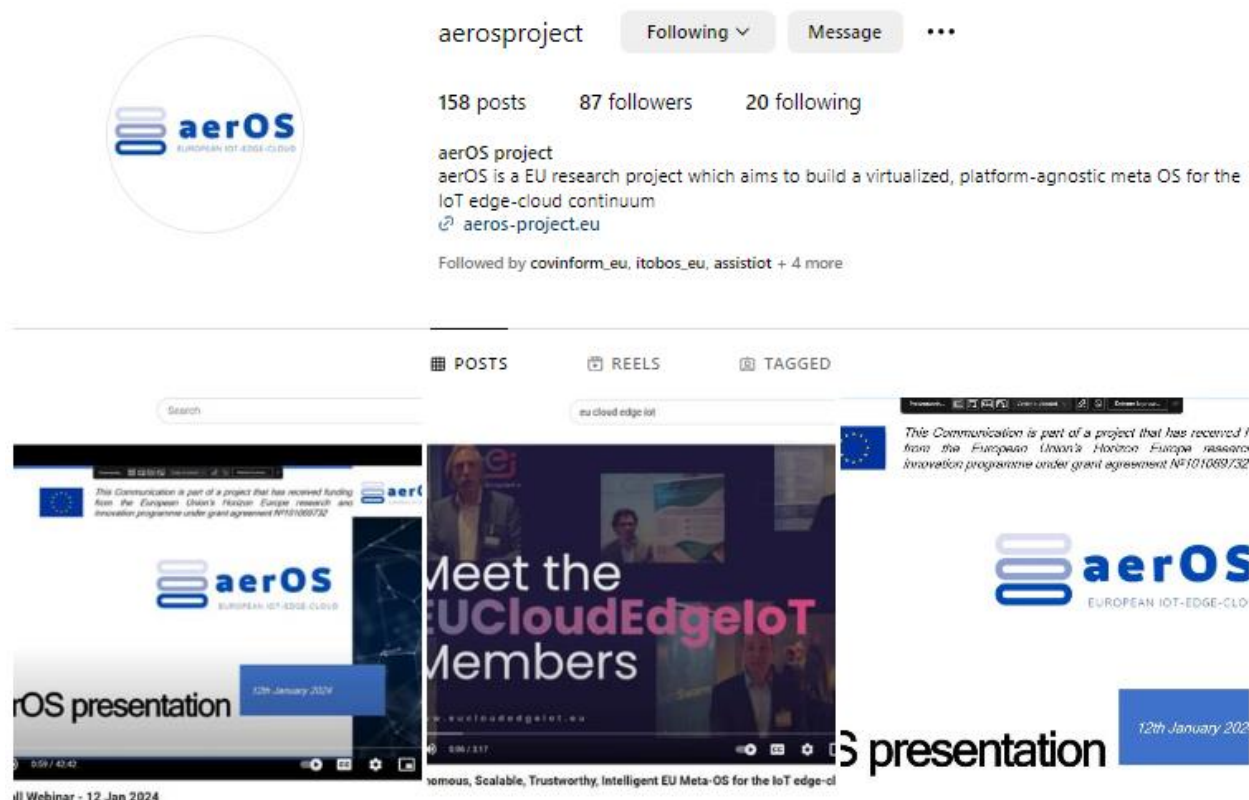


Figure 7 Instagram account

2.1.1.2.5. YouTube channel

YouTube, as a leading online video platform, plays a key role in increasing audience engagement, given that videos are generally more engaging than text or images. Leveraging YouTube enables the aerOS project to reach a global audience and improve visibility through Google search. Regular production of video content throughout the project is expected to further enhance audience interaction.

The aerOS YouTube channel, accessible at <https://www.youtube.com/@aeros-project>, is continuously updated, with 49 videos already available at M38. The channel serves as a hub for promoting and showcasing project events, as well as sharing videos from workshops and presentations. Following YouTube's latest policies, the channel uses the handle @aeros-project, providing a concise and memorable link for communication purposes. By the end of the reporting period (October 2025), all five aerOS pilots are expected to have dedicated videos uploaded, presenting an overview of each pilot, its infrastructure, the developments achieved so far, and the use cases being supported within the aerOS project (Figure 8).

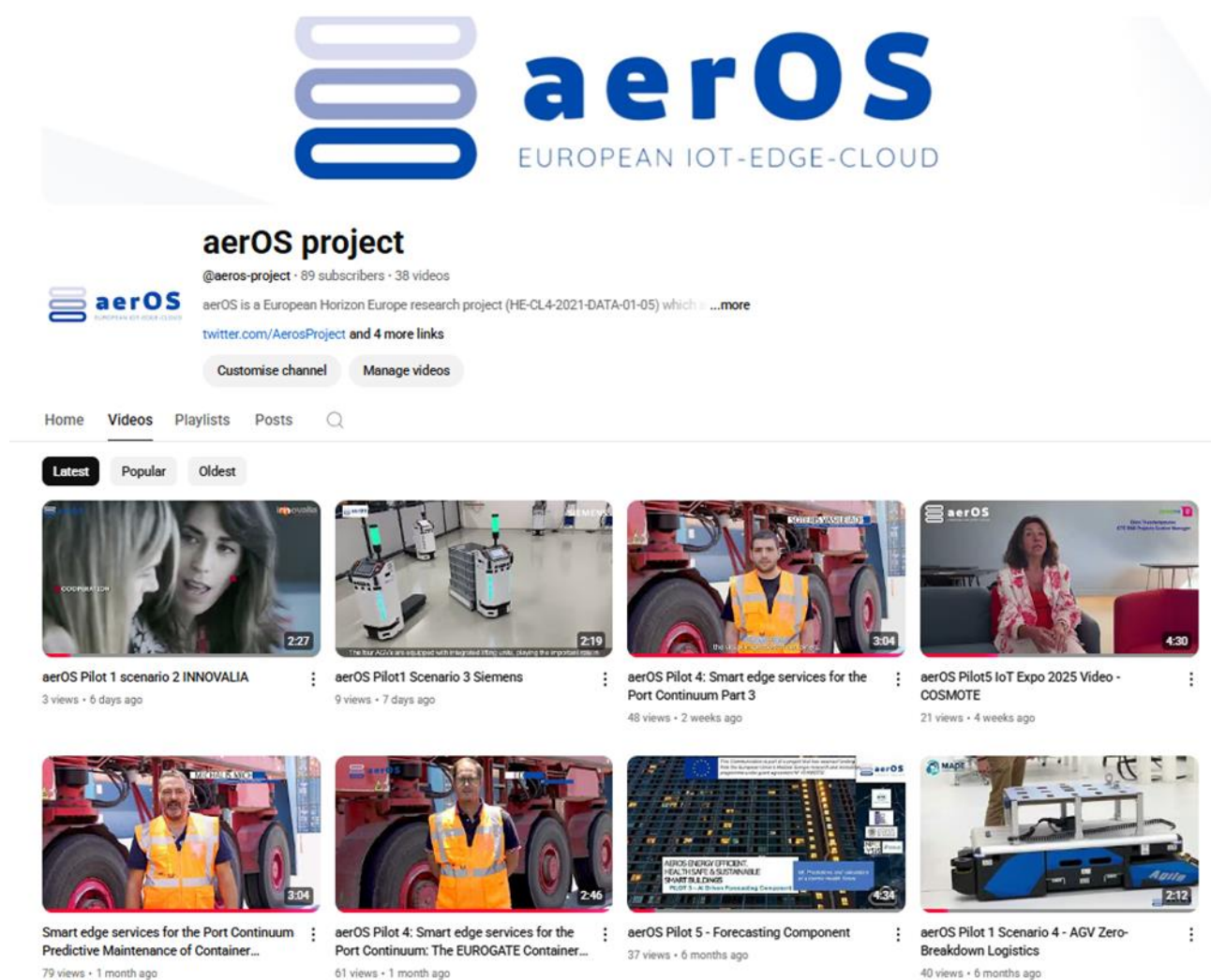


Figure 8 YouTube channel

2.1.1.3. aerOS poster

In addition to its communication strategies, the aerOS project utilizes posters as a supportive tool. These posters, with the first aerOS poster accessible at https://aeros-project.eu/wp-content/uploads/2023/01/Poster-aerOS_A0_84x118cm_WEB.pdf, play a crucial role in various dissemination and communication initiatives such as workshops, booths, presentations, webinars, seminars, trainings, and trials.

The main objective of these posters is to provide informational support by offering the audience compact and comprehensive insights into the project, its objectives, and the ongoing pilot activities (Figure 9). During the period additional poster version and rollups per pilot were designed.

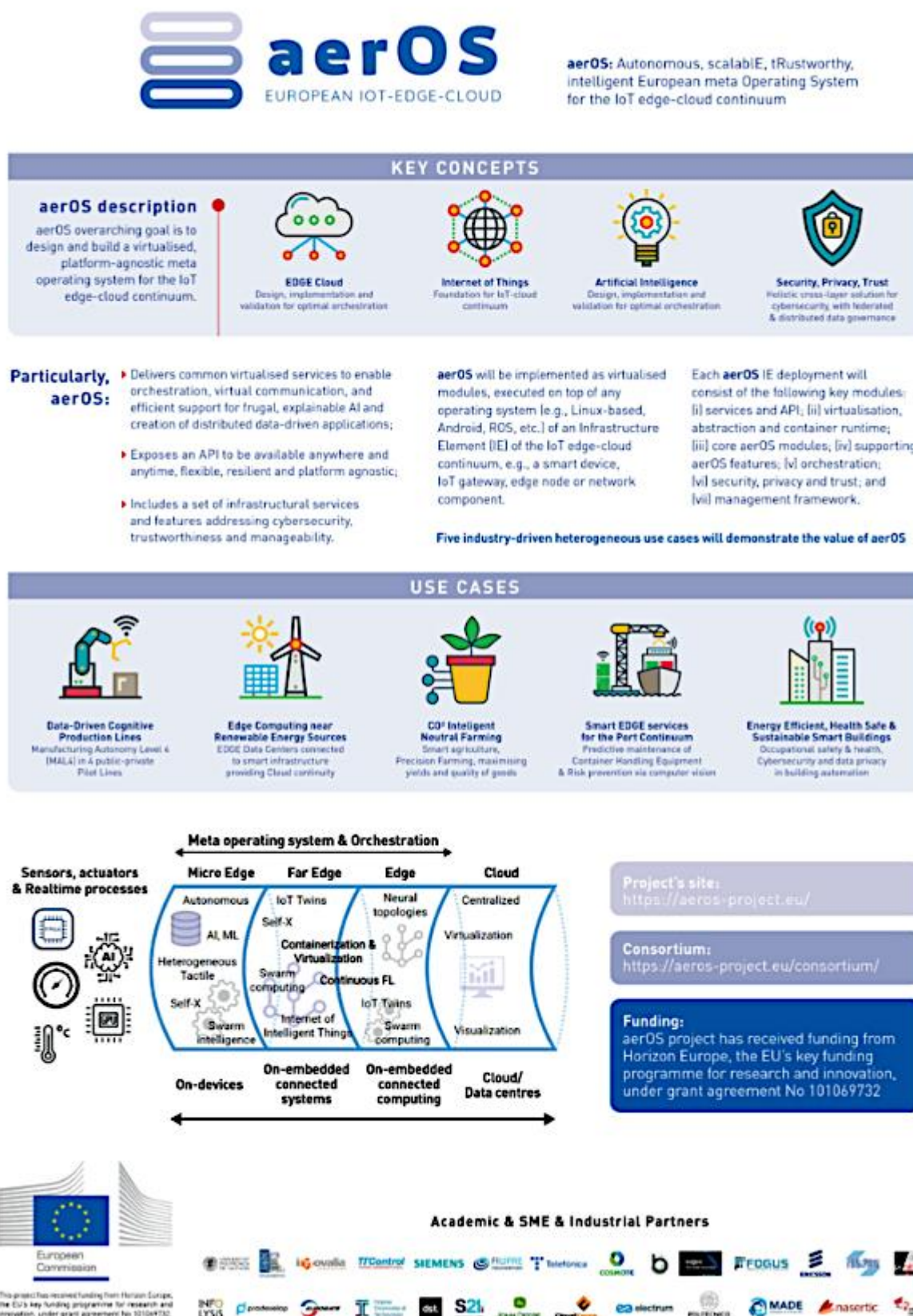


Figure 9 aerOS poster

2.1.1.4. aerOS Leaflet

aerOS leaflet is considered as the printed material designed for the purpose of conveying information and promoting the aerOS project. These leaflets can be distributed either digitally or in print and are commonly handed out at public events such as conferences and workshops.

Typically, leaflets offer concise information on a specific topic, including details like contact information, an overview of the project, or promotional offers. They serve to highlight and draw attention to the goals or causes associated with the aerOS project.

The initial version of the aerOS leaflet is already available in digital format on the aerOS website at https://aeros-project.eu/wpcontent/uploads/2023/01/aerOS_leaflet-v0.2.pdf. During the period additional leaflets per pilot were designed and made available through the website's dedicated pilot webpages.



The image shows the first page of the aerOS leaflet. It features a blue header with the aerOS logo and a network diagram. The main title is 'ABOUT aerOS'. Below this, there are four columns of text describing the project's goals and challenges. A central section highlights key statistics: 12 M€, 27 partners, 11 countries, and 3 years. This is followed by a section titled 'aerOS CAPABILITIES' which lists five key capabilities: Modular and Holistic Data Autonomy, Service Smartness Suite, DevPrivSecOps Continuum, Autonomous Continuum Management, and Federated Orchestration. The final section is 'aerOS TECHNICAL FOUNDATION' which lists four technical pillars: EDGE Cloud, Internet of Things, Artificial Intelligence, and Security, Privacy, Trust, each with a brief description.

ABOUT aerOS

Rapidly increasing data volumes and computing capabilities of smart devices enables processing to be performed closer to the data sources (devices); i.e., edge computing. In fact, the global edge computing market size will reach 7.013 M€ in 2028, responding to a CAGR of 36,2 %.

Traditional cloud services move towards commoditisation. The challenge is now leveraging a IoT **edge-cloud continuum**, as an extended network computing fabric between physical devices and cloud.

aerOS, starting 1st September 2022, tackles this need by the development of a meta Operating System (metaOS) for an heterogeneous and segmented/federated IoT **edge-cloud continuum**, which will enable the orchestration hyper-distributed applications.

aerOS will deliver a next generation high level meta-OS for IoT and open **edge-cloud continuum** ecosystems, SME friendly and with strong computing capability, contributing to the increase of European autonomy in data processing.

12 M€ **27 partners** **11 countries** **3 years**

aerOS CAPABILITIES

Modular and Holistic Data Autonomy: aerOS will include an advanced management and control of data, automated and efficient management of resources and operations.

Service Smartness Suite: Automated self-X processes for infrastructure elements, frugal and explainable AI, benchmarking tools for gathering metrics and advanced embedded real-time analytics.

DevPrivSecOps Continuum "by-design": aerOS will offer the most innovative protection techniques in real time, including privacy in access, trust and data sovereignty by design.

Autonomous Continuum Management: automation of deployment, maintenance and management process of components.

Federated Orchestration: aerOS will offer an intelligent orchestration, allowing an efficient and automated deployment of new resources, services and tools.

aerOS TECHNICAL FOUNDATION

EDGE Cloud
Design, implementation and validation for optimal orchestration

Internet of Things
Foundation for IoT edge-cloud continuum

Artificial Intelligence
Design, implementation and validation for optimal orchestration

Security, Privacy, Trust
Holistic cross-layer solution for cybersecurity, with federated & distributed data governance

Figure 10 aerOS leaflet 1st page

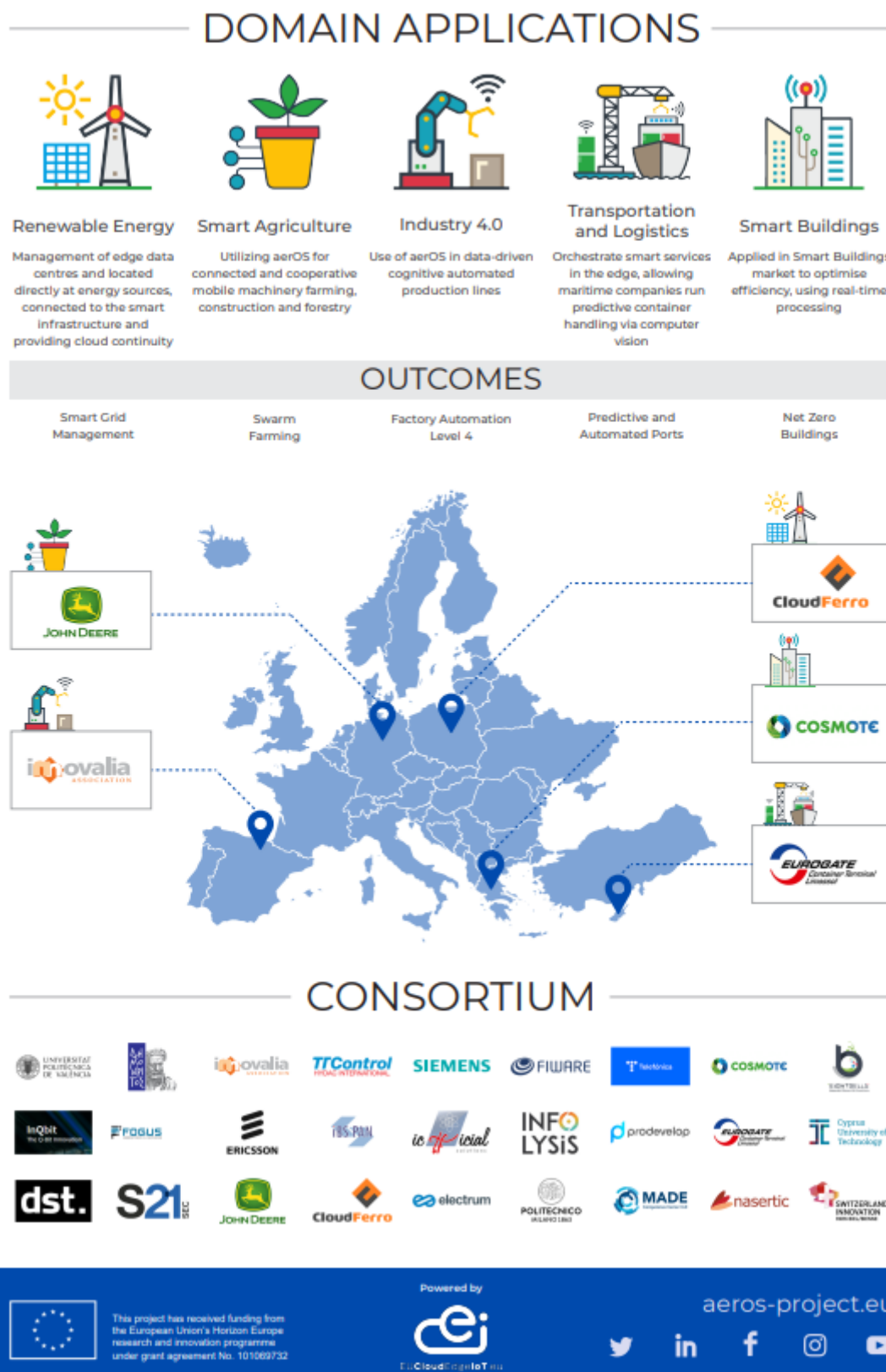


Figure 11 aerOS Leaflet 2nd page

2.1.1.5. aerOS Updated Pilot section

The Pilots section of aerOS has been comprehensively updated to showcase the latest developments across all pilot scenarios, offering a rich mix of new leaflets and immersive video content (addressing in this way also the reviewers' comment for more dedicated pilots content in the aerOS website). Each pilot, from Pilot 1 (covering Scenarios 1–4) through Pilot 5, now presents detailed documentation that outlines objectives, technical architecture, implementation strategies, and observed outcomes. Complementing the written materials, the videos provide visual demonstrations of system deployment, real-time orchestration, AI integration, and edge-to-cloud interactions. This combination of resources allows stakeholders, researchers, and industry partners to gain a deep, practical understanding of aerOS in action across diverse real-world environments, highlighting its flexibility, efficiency, and scalability. You may access all the pilot information here: <https://aeros-project.eu/use-cases/>. For each Pilot menu, (a) a dedicated webpage on pilot details (in the form also of a downloadable leaflet) and (b) a webpage promoting pilot's videos and demos, are available.



aerOS
EUROPEAN IoT EDGE CLOUD

aerOS: Autonomous, scalable, trustworthy, intelligent European meta Operating System for the IoT edge-cloud continuum

PILOT 5: Energy Efficient, Health Safe & Sustainable Smart Buildings

OTE, NCSR Demokritos, Fogus Innovations & Services, InfoLysis, Polytechnic University of Valencia

Pilot & Scenario Overview

Enterprise buildings can save energy by using advanced sensors and automated controls in HVAC (Heating, Ventilation and Air Conditioning) taking advantage of building automation with data analytics. At the same time in the last years, the Coronavirus pandemic disruptively affected the traditional work norms, stranding previously crowded office buildings and embracing flexible working and mobile workspaces. Evidently, the post-pandemic workplaces have become open spaces with proper employees' placement, energy efficiency, business and personal preferences becoming a complex and dynamic task. In this transformation towards flexible, safe, and sustainable workplaces, IoT technology and Analytics through the aerOS capabilities can offer a unique, autonomous solution towards safe and sustainable workplaces. That solution can be deployed in a diverse set of buildings, employing plethora of IoT solutions aligned to the IoT sourcing strategy of each enterprise.

This use case, implemented in an office building of OTE (Athens, Greece) and driven by partners OTE, NCSR, FOGUS, INF and UPV, aims to demonstrate gains of the aerOS architecture in an edge deployment for energy efficient, sustainable, flexible, and health-safe smart buildings. A wide number of IoT devices furnished with the aerOS capabilities are deployed to meter energy, luminosity, CO₂, humidity, temperature, motion detection, and desk occupancy. The data collected in conjunction with the AI-generated recommendations towards minimizing energy consumption and maximizing health measures are used to determine the appropriate clustering of employees in the offices and deduce the recommended employees seating while exploited to actuate appropriately the ventilation, heating and air-condition systems and control luminosity.

Infrastructure & Technology

The pilot consists of the following systems:

- An end-to-end IoT application, already developed by OTE and adapted following the aerOS Domain and Infrastructure Element concepts and re-architected to incorporate the aerOS high-level and low-level automation, that includes:
 - Front-end, incorporating a variety of sensors, orchestrated by IoT Gateways
 - Back-end applications, including InfluxDB, MQTT, Grafana, Prometheus, HomeAssistant
 - Health & Energy Optimization AI System
 - Seat Recommendation System
 - End-user application

All the pilot components have been designed to support the semantics interoperability developments of the project, using the FIWARE context broker.

Objectives & Benefits

Energy Efficient, Health Safe & Sustainable Smart Buildings Use Case aims to exhibit how the aerOS platform agnostic meta-operating system for the IoT-cloud-edge continuum can be applied in the Smart Buildings applications domain. Key objectives include:

1. Implement the aerOS architecture in Smart Buildings market to optimize the efficiency and safety of enterprises based on process and data autonomy and self-orchestrated IoT ecosystems.
2. Demonstrate energy efficiency of the large buildings using real-time processing and (frugal) AI.

With multiple IoT vendors and solutions, tech integration, so that sensors, systems, analytics work in sync, becomes a considerable obstacle. Through the application of the aerOS architecture the customer and end-users will enjoy the following benefits:

- Smart building technologies can provide facilities' operators with the tools to anticipate and proactively respond to maintenance, comfort, and energy performance issues, resulting in better equipment maintenance, higher occupant satisfaction, and reduced energy consumption and costs.
- The pilot proposes a unique combination of energy-efficient and health-safe buildings by utilizing a distributed AI approach for proper employees' placement, addressing social distancing and energy efficiency, along with business and personal preferences and work habits.
- The pilot is IoT-technology agnostic and can dynamically adopt and adapt to changes in infrastructures using automated orchestration solutions.
- The pilot deployment can dynamically scale-in and out (e.g. add/remove rooms, floors and buildings) and integrate in a bigger ecosystem by leveraging the distributed autonomy, federated architecture and interoperability assured by aerOS node principles providing flexibility to support customers' target infrastructures and business plans.
- The pilot is exploiting to the maximum open-source, community best-practices and as such is a state-of-the-art cost-effective, future proof solution.

CONSORTIUM

Partners: OTE, NCSR, FOGUS, INF, UPV, InfoLysis, Polytechnic University of Valencia, Siemens, FIWARE, Telefónica, b, dst, S2i, cloudflare, electron, MADE, nasorbic, etc.

Powered by:   aeros-project.eu

PDF

Figure 12 aerOS material from the updated Pilot Section

2.1.1.6. aerOS Newsletter

The aerOS project release newsletters on a quarterly basis, with the inaugural issue already available at <https://aeros-project.eu/dissemination/newsletter/>. These newsletters serve as a means to briefly communicate the project's activities and achievements during each three-month period. Each newly published edition is uploaded on the project's website and shared across its social media channels. Stakeholders can conveniently access and download the newsletters for reading. Additionally, partners are notified of the release through internal mailing lists, ensuring they are kept informed about each new issue.

As we can see in Table 4 up to M38, 11 issues have been released, while 1 is under editing (to be released early November 2025).

Table 4 aerOS Newsletter Issues

#	Newsletter Period	URL link
1	September – November 2022	https://aeros-project.eu/wp-content/uploads/2022/12/aerOS-newsletter-1.pdf
2	December 2022 – February 2023	https://aeros-project.eu/wp-content/uploads/2023/03/aerOS-newsletter-2.pdf
3	March – May 2023	https://aeros-project.eu/wp-content/uploads/2023/06/aerOS-newsletter-3.pdf
4	June – August 2023	https://aeros-project.eu/wp-content/uploads/2023/09/aerOS-newsletter-4.pdf
5	September – November 2023	https://aeros-project.eu/wp-content/uploads/2023/12/aerOS-newsletter-5.pdf
6	December 2023 – February 2024	https://aeros-project.eu/wp-content/uploads/2024/03/aerOS-newsletter-6.pdf
7	March – May 2024	https://aeros-project.eu/wp-content/uploads/2024/06/7.pdf
8	June – August 2024	https://aeros-project.eu/wp-content/uploads/2024/09/aerOS-newsletter-8.pdf
9	September – November 2024	https://aeros-project.eu/wp-content/uploads/2024/12/aerOS-newsletter-9-.pdf
10	December 2024 – February 2025	https://aeros-project.eu/wp-content/uploads/2025/04/10.pdf
11	March 2025 – May 2025	https://aeros-project.eu/wp-content/uploads/2025/10/aerOS-newsletter-11.pdf
12	June 2025 – October 2025	Under Editing - To be released end of Oct – Beginning of Nov 2025

2.1.1.7. aerOS articles

The partners of the aerOS project have communicated information about the project through online articles, many of which have been widely shared on various news portals. Up to M38, aerOS project has 16 articles edited by the members of the consortium (Table 5) and 3 interviews (in the form of videos available at YouTube)

Table 5 aerOS articles

#	Media	URL link
1	upv.es	http://www.upv.es/noticias-upv/noticia-13836-proyecto-aeros-es.html
2	valenciaplaza.com	https://valenciaplaza.com/la-upv-lidera-un-proyecto-europeo-que-aplica-ia-y-computacion-para-energia-y-edificios-inteligentes
3	europapress.es	https://www.europapress.es/navarra/noticia-navarra-participa-proyecto-europeo-aeros-mejorar-gestion-datos-recursos-informaticos-ue-20220704110717.html
4	lasprovincias.es	https://www.lasprovincias.es/comunitat/lid-era-proyecto-aplica-20221107004649-ntvo.html
5	gentedigital.es	http://www.gentedigital.es/valencia/noticia/3498265/la-upv-lidera-un-proyecto-europeo-que-aplica-ia-y-compu%e2%80%a6/
6	elmeridiano.es	https://www.elmeridiano.es/la-upv-lidera-un-proyecto-ue-para-el-desarrollo-de-un-meta-sistema-operativo/
7	mikrofwno.gr	https://mikrofwno.gr/2023/05/defea-2023/
8	EUCloudEdgeIoT.eu	https://eucloudedgeiot.eu/communication-horizon-context/
9	irisnavarra.com	https://www.irisnavarra.com/es/noticias/eres-una-pyme-o-una-entidad-investigadora-y-estas-desarrollando-una-propuesta-o-solucion
10	EUCloudEdgeIoT.eu	Meta OS Workshop: Ideas and Strategies for the Future of the Computing Continuum
11	sipbb.ch, SSF Open Day – 10.12.2024	https://www.sipbb.ch/en/ssf-open-day-10-12-2024
12	Spotlight use case categories, Agriculture	https://eucloudedgeiot.eu/agriculture/
13	Spotlight use case categories, Manufacturing	https://eucloudedgeiot.eu/manufacturing/
14	Spotlight use case categories, Energy and Utilities	https://eucloudedgeiot.eu/energy-and-utilities/
15	Spotlight use case categories, Transportation	https://eucloudedgeiot.eu/transportation/
16	2nd Workshop on Advancements in Research Infrastructures, Adaptive Frameworks, and Global Architectural	https://eucloudedgeiot.eu/event/2nd-workshop-on-advancements-in-research-infrastructures-adaptive-frameworks-and-

	Evolution (ATHENA 2025)	global-architectural-evolution-athena-2025/
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2.1.1.8. aerOS press releases

Multiple partners have unveiled the involvement in the aerOS project through official announcements and press releases featured on their company websites. These announcements likely provide detailed insights into the partner's role, contributions, and enthusiasm for being a part of the aerOS initiative.

Typically, these materials may highlight key aspects such as the significance of the project, the partner's specific contributions, and the collaborative efforts aimed at achieving the project's objectives. The use of announcements and press releases on individual company websites ensures that stakeholders, clients, and the public can access accurate and up-to-date information about the partner's engagement in the aerOS project.

Currently, 11 press releases have been made by specific consortium members (Table 6)

Table 6 aerOS press releases

#	Press Release	URL link
1	aerOS announced at Nasertic website	https://www.nasertic.es/es/proyectos#aeros
2	aerOS announced at Prodevelop website	https://www.prodevelop.es/en/ports/idi-puertos
3	aerOS announced at NCSR “Demokritos” website	https://www.iit.demokritos.gr/projects/autonomous-scalable-trustworthy-intelligent-european-meta-operating-system-for-the-iiot-edge-cloud-continuum/
4	aerOS announced at 8Bells website	https://www.8bellsresearch.com/eight-bells-is-very-proud-to-participate-in-aeros-project/
5	aerOS announced at DST website	https://www.dstech.it/progetti-finanziati.html
6	aerOS announced at OTE’s website	https://www.cosmoteOTE.gr/cs/otegroup/en/aeros.html
7	aerOS announced at FIWARE’s website	https://www.fiware.org/about-us/rd-projects/project/?id=aeros
8	aerOS announced at CloudFerro’s website:	https://cloudferro.com/en/news/cloudferro-in-aeros-project/
9	aerOS announced at Cyberwatching.eu	https://www.cyberwatching.eu/projects/3475/aeros
10	aerOS announced at MADE website	https://www.made-cc.eu/en/projects/aeros/
11	aerOS announced at NEPHELE website	https://nephele-project.eu/ecosystem/aeros

2.1.2. Control/Monitoring Mechanisms, Performance Monitoring, Special Communication actions

The aerOS consortium has set dedicated monitoring methods to meticulously monitor all scheduled communication and dissemination activities. These tools regularly evaluate the efficacy of the project's website and social media platforms. Such monitoring mechanisms are crucial as they provide valuable insights, gauge the consortium's impact, and illustrate the project's progression. Moreover, these tools facilitate effective collaboration among the consortium's members.

2.1.2.1. NextCloud, Online Repository and Coordination Files

The aerOS partners utilize the NextCloud platform as a collaborative instrument to facilitate the sharing of materials and content. This platform is structured into categorized sections comprising folders and sub-folders, allowing seamless distribution and enhanced organization of the project's materials. The NextCloud platform plays a major role in enabling efficient communication and collaboration among members within the consortium. It incorporates multiple specifically designated folders corresponding to each Work Package and Task, along with the capability for online file editing—a feature significantly beneficial for documenting communication activities. More information about the NextCloud and its use as tool for WP6 can be found in [deliverable D6.1](#).

2.1.2.2. Google analytics and statistical dashboards

Google Analytics stands as an indispensable tool for monitoring and assessing website performance within any digital marketing strategy. Its capacity to offer detailed and sophisticated data, along with various metrics and functionalities, is invaluable for evaluating a website's impact. However, it is the responsibility of the administrator to discern and prioritize the pertinent information aligned with the website's objectives and communication strategy. Within the aerOS framework, the communication team utilizes Google Analytics to monitor the aerOS website's performance monthly, and internally disseminate statistics on a quarterly basis. Prompt identification of any deviations or poor performance will prompt immediate corrective actions.

In the context of the aerOS project, Google Analytics serves not only to monitor and assess website efficiency but also as a data source for Looker Studio (ex-Google Data Studio). INFOLYSIS, has created tailor-made Website Statistical Dashboards to facilitate more comprehensive data analysis and visualization, focusing on specific metrics of website performance. This customized aerOS dashboards provide a holistic visual statistical overview of the website's performance to all consortium members on a quarterly basis (Table 7).

Table 7 Social media terminology

Term ³⁴	Explanation
Engagement	Engagement is any form of interaction with your brand on social media. Likes, comments, and shares are all forms of engagement.
Handle	Your handle is your username on social media. It is usually noted as @username. (see YouTube)
Hashtag	A hashtag is a word or phrase preceded by the “#” sign. Hashtags are used on social media to tag posts as part of a larger conversation
Impressions	Impressions is a metric that counts how many times an ad or promoted posts is fetched from the server and displayed on a social network.
Reach	Reach refers to the total number of people who have been exposed to a social post or ad. This metric does not necessarily indicate that all of these people

³<https://blog.hootsuite.com/social-media-definitions/>

⁴<https://www.hotjar.com/google-analytics/glossary/sessions/>

	have actually seen your content. They could have scrolled right past it, for instance. Reach simply indicates that the content appeared in the user's social feed at least once.
Session	Refers to the set of actions taken by a user on your website in a given time frame
User	The visitor who has initiated the session and visits the website

2.1.3. Period Statistical Dashboards (M19-M37)

2.1.3.1. Website dashboard

The aerOS website dashboards, created in Looker Studio with Google Analytics data, provide an overview of site performance. Key metrics include 12,453 sessions, an average session duration of 56 seconds, and total page views. Users mainly accessed the site directly (3,157), via Google (2,192), or LinkedIn (132). Most visitors came from the USA (1,859), Spain (862), and Greece (587). Device usage shows 71.9% desktop, 23.4% mobile, and 4.2% tablet (Figure 13). Website dashboard available at <https://lookerstudio.google.com/u/2/reporting/cced511a-4961-4b25-a46a-f33710163d67/page/pmtsB>

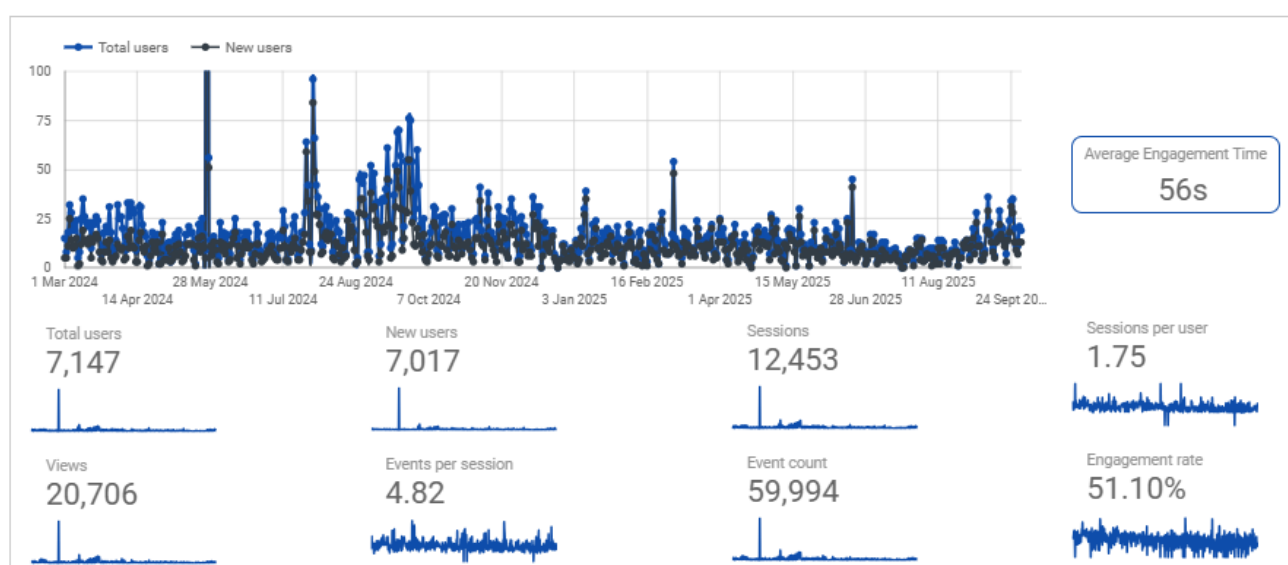


Figure 13 Website Statistical Dashboard 1

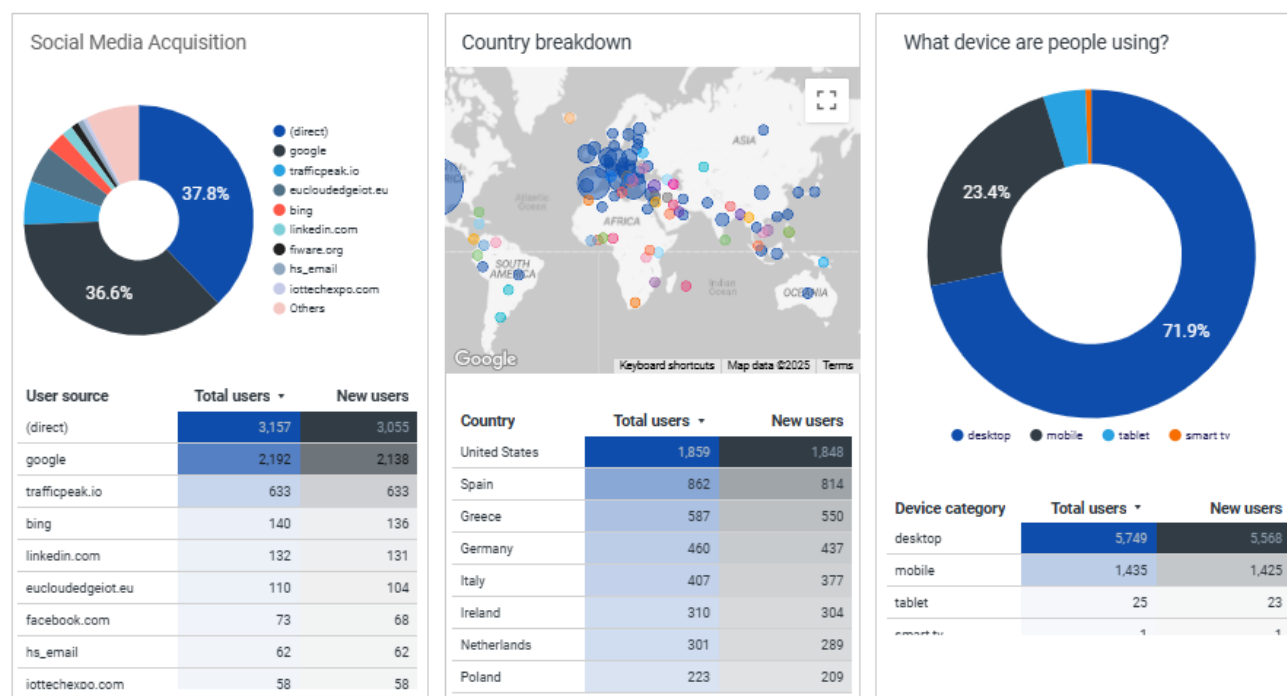


Figure 14 Website Statistical Dashboard 1

2.1.3.2. Social Media Statistical Dashboards

- **LinkedIn Dashboard**

Using the same methodology as the website dashboard. It features an infographic of post views, a dropdown to explore individual posts, and Period and Total Statistics summarizing posts, views, likes, reshares, followers, and connections. This standardized format ensures clear presentation of key metrics across all social media dashboards (Figure 15). The dashboard is available here: <https://lookerstudio.google.com/u/0/reporting/4c38617f-2fda-4ec7-a5b0-303f7a8e083c/page/1SSqB>

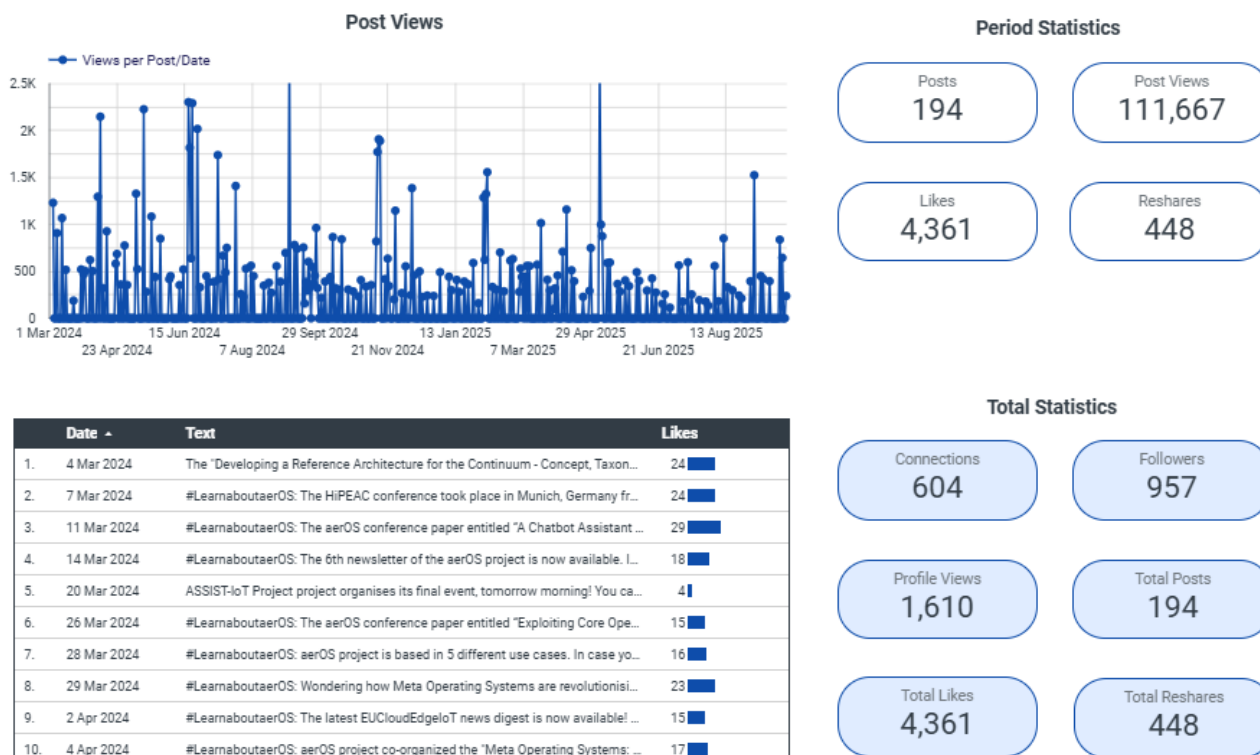


Figure 15 LinkedIn Dashboard

• X Dashboard

The INFOLYSiS team created the X Dashboard in Looker Studio to track aerOS X performance for this specific period. Key metrics include 201 tweets, 475 retweets, and 297 followers. The dashboard provides a comprehensive overview of the account's activity and can be accessed here: <https://lookerstudio.google.com/u/0/reporting/55d5c017-d8ab-494d-b069-5bad2eb0793d/page/4YFqB>



aerOS X (formerly Twitter) Dashboard Mar 2024-Sep 2025 Statistics

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No. 101069732

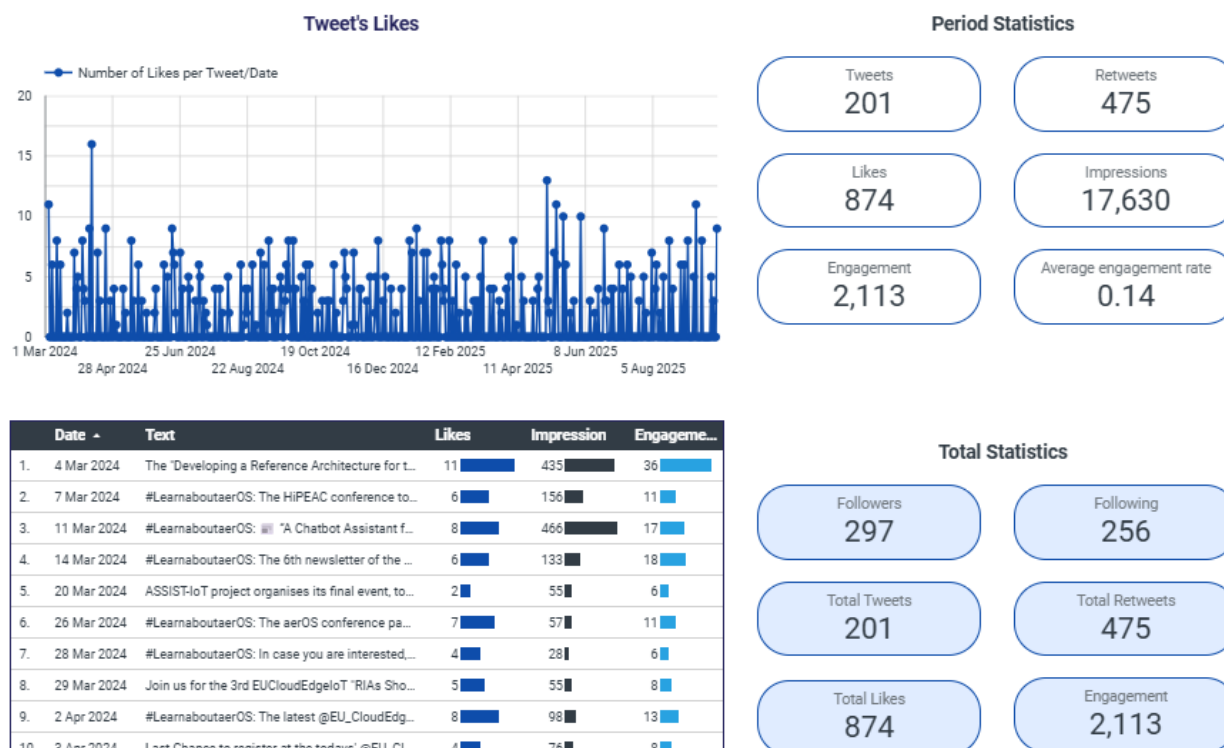


Figure 16 X Dashboard

- Facebook Dashboard

The Facebook Dashboard provides key metrics for the selected period, including 180 posts and a page reach of 4,262. The dashboard, covering September 2022 to September 2025, is available here: <https://lookerstudio.google.com/u/0/reporting/a7029793-5ac0-4b36-8bac-ba85049f7292/page/j5mpB>

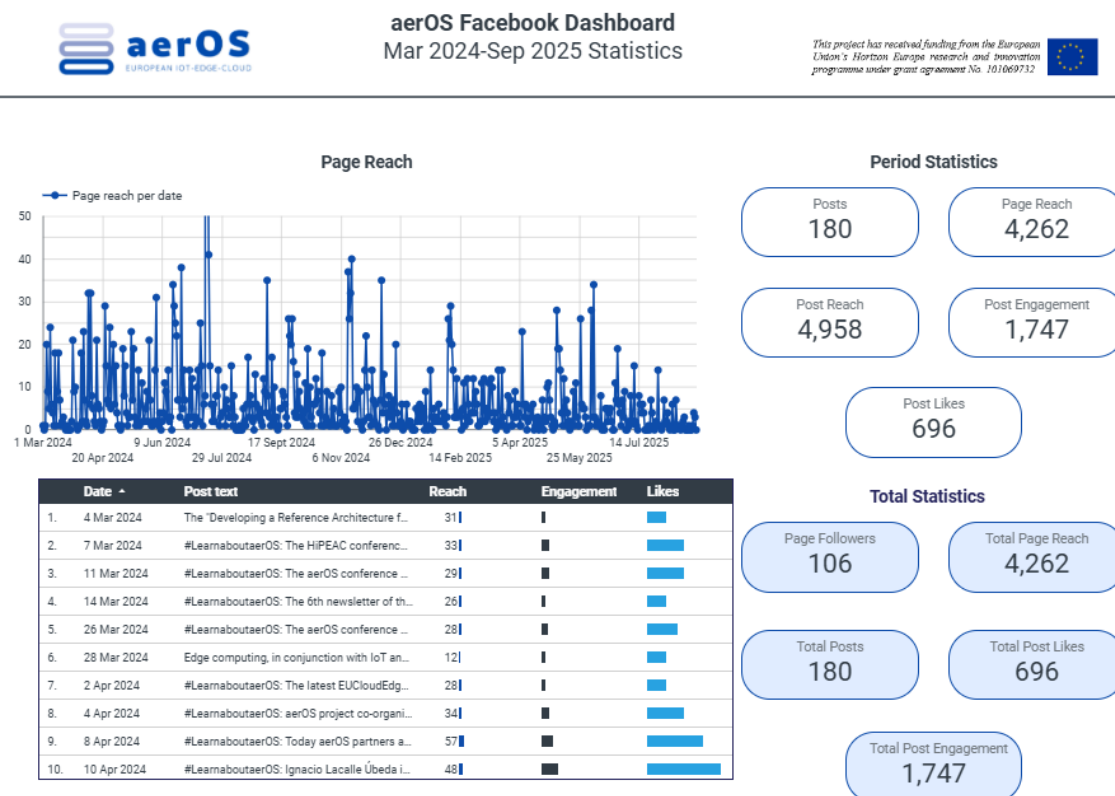


Figure 17 Facebook Dashboard

- Instagram Dashboard**

In the following link one may access the aerOS Instagram Dashboard for the period of March 2024 – September 2025: <https://lookerstudio.google.com/u/0/reporting/64d84562-b8ad-417d-9d5e-5b656aead2d6/page/rKQqB>. During the reporting period, the aerOS Instagram account has 666 total likes, from total of 171 posts (Figure 18).

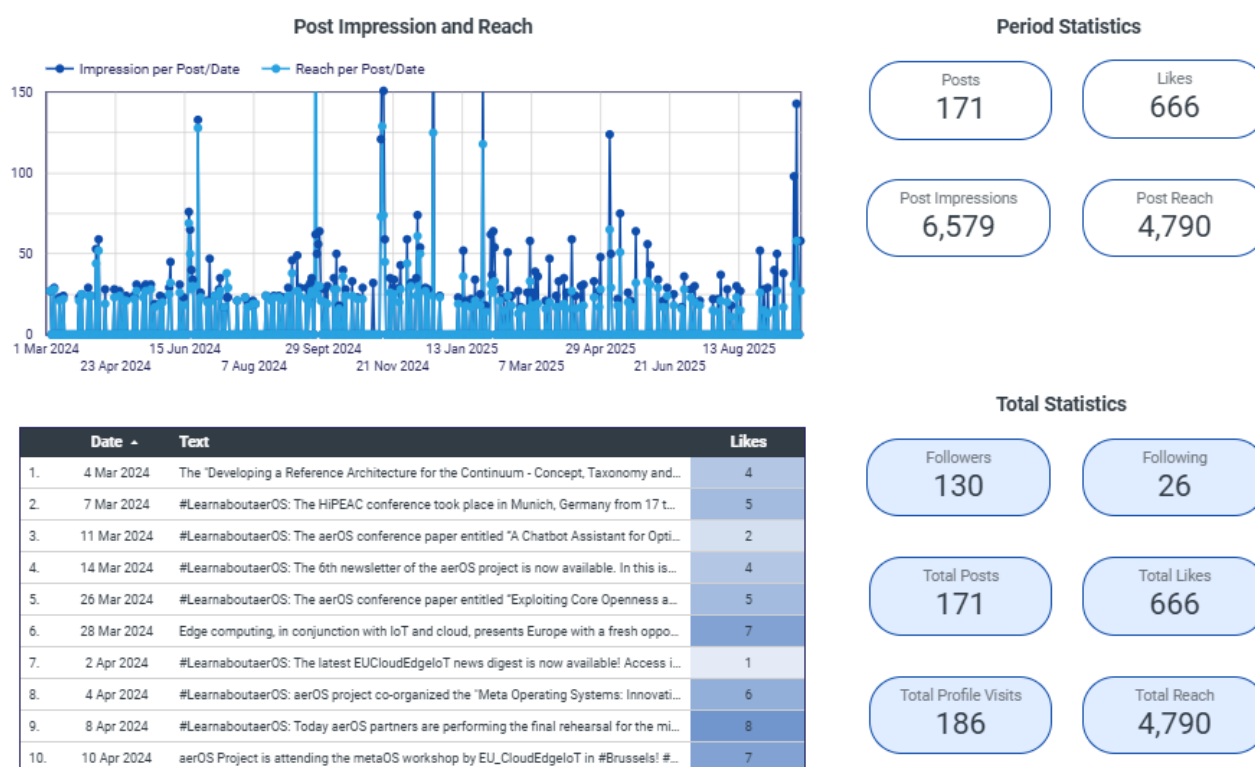


Figure 18 Instagram Dashboard

2.1.4. Total Statistical Dashboards (M1-M37)

2.1.4.1. Website dashboard

The statistical dashboards on the aerOS website, illustrated in Figures 19 and 20 and generated using Looker Studio with data from Google Analytics, provide a detailed overview of the site's usage and performance from September 2022 to September 2025 (October 2025 data will be processed and accumulated in the dashboard by middle of November 2025, and will be presented during the final review in December 2025). Key metrics include 23,374 sessions, new user statistics, an average session duration of 1 minute and 30 seconds, and total page views. Figure 19 highlights the main access pathways, showing that 5,574 users arrived directly, 3,769 via Google search, and 282 through LinkedIn. Figure 20 provides insights into the geographical distribution of visitors, with the majority from USA (2,384) and Spain (1,628), and additional traffic from the Greece (1,210). The dashboards also reveal device preferences, indicating that 70.8% of users accessed the website via desktop, 24.9% used mobile devices, and 3.9% visited using tablets.

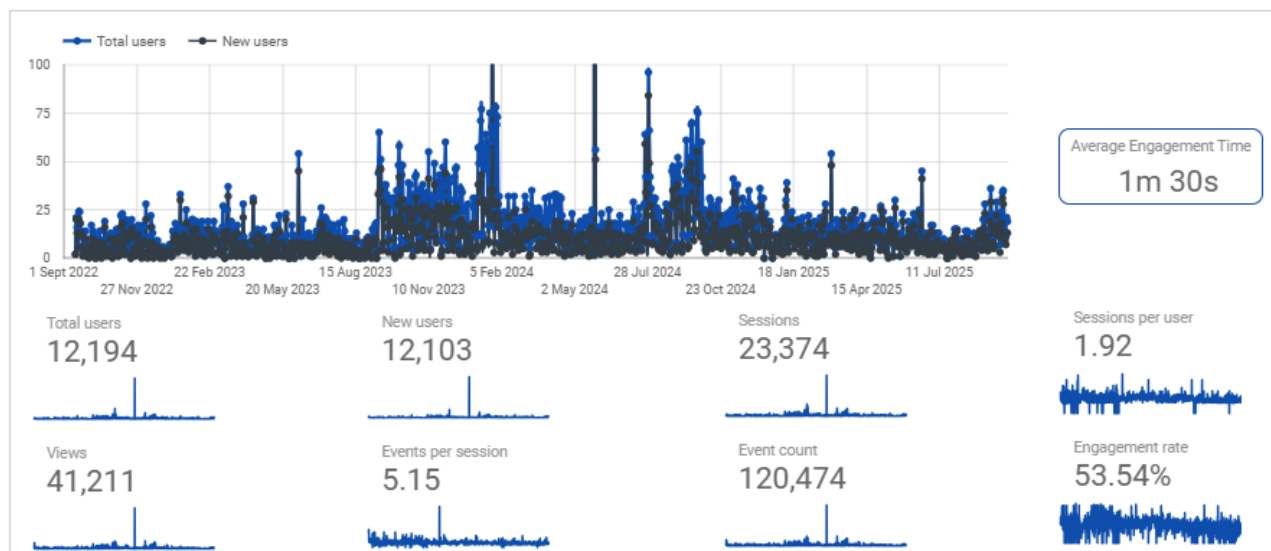
The audience at a glance


Figure 19 Website Statistical Dashboard 1

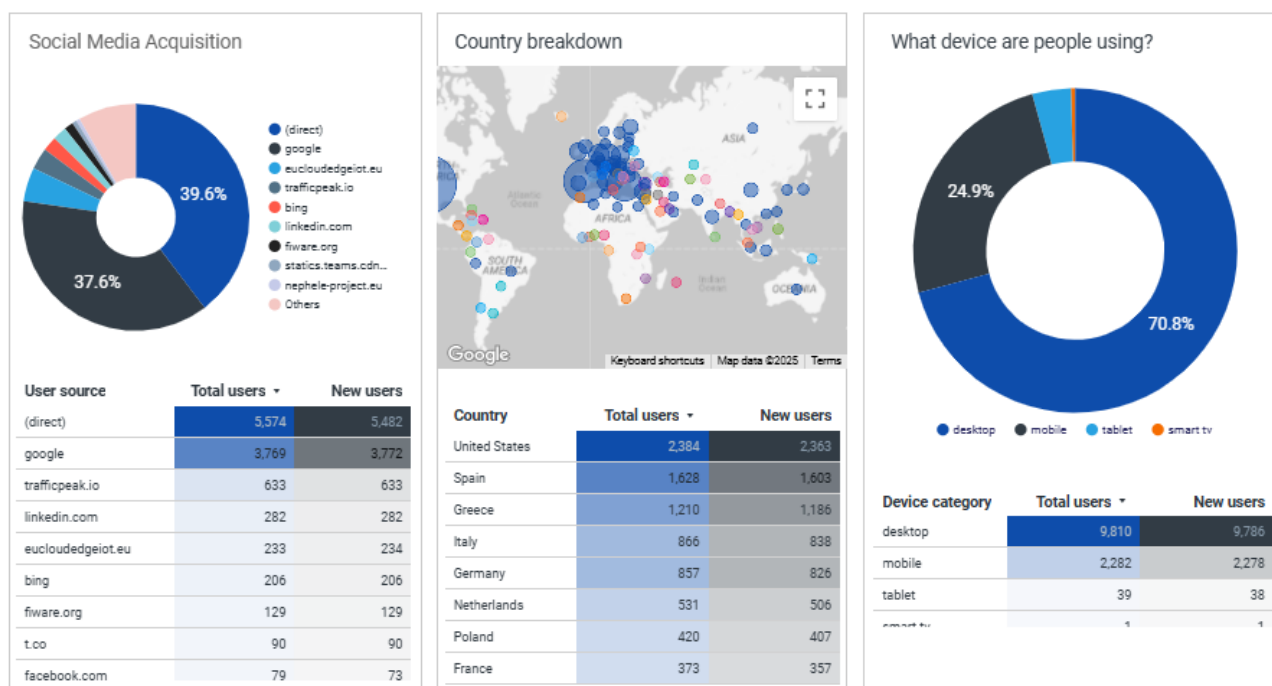


Figure 20 Website Statistical Dashboard 2

Find all the related information about the website M1-M40 dashboards here:
<https://lookerstudio.google.com/u/0/reporting/7a1e3841-0c49-4ea9-baa0-a3b73374bcd4/page/pmtsB>

2.1.4.2. Social Media Statistical Dashboards

1. LinkedIn Dashboard

Using the same approach applied for the website, the INFOLYSiS team created the LinkedIn Dashboard in Looker Studio, shown in Figure 21, to analyze the performance of the aerOS LinkedIn account. The dashboard features an infographic displaying post views and a dropdown menu listing individual posts, enabling stakeholders to explore each post's metrics. On the right side, the Period and Total Statistics sections provide detailed information on the total number of posts, views, likes, reshares, followers, and connections during the selected timeframe. This consistent format is applied across all social media dashboards to present the most relevant metrics clearly and comprehensively. The LinkedIn Dashboard can be accessed through the following link: <https://lookerstudio.google.com/u/0/reporting/759c2daa-09c5-4d97-9767-7d09c5d539f6/page/1SSqB>

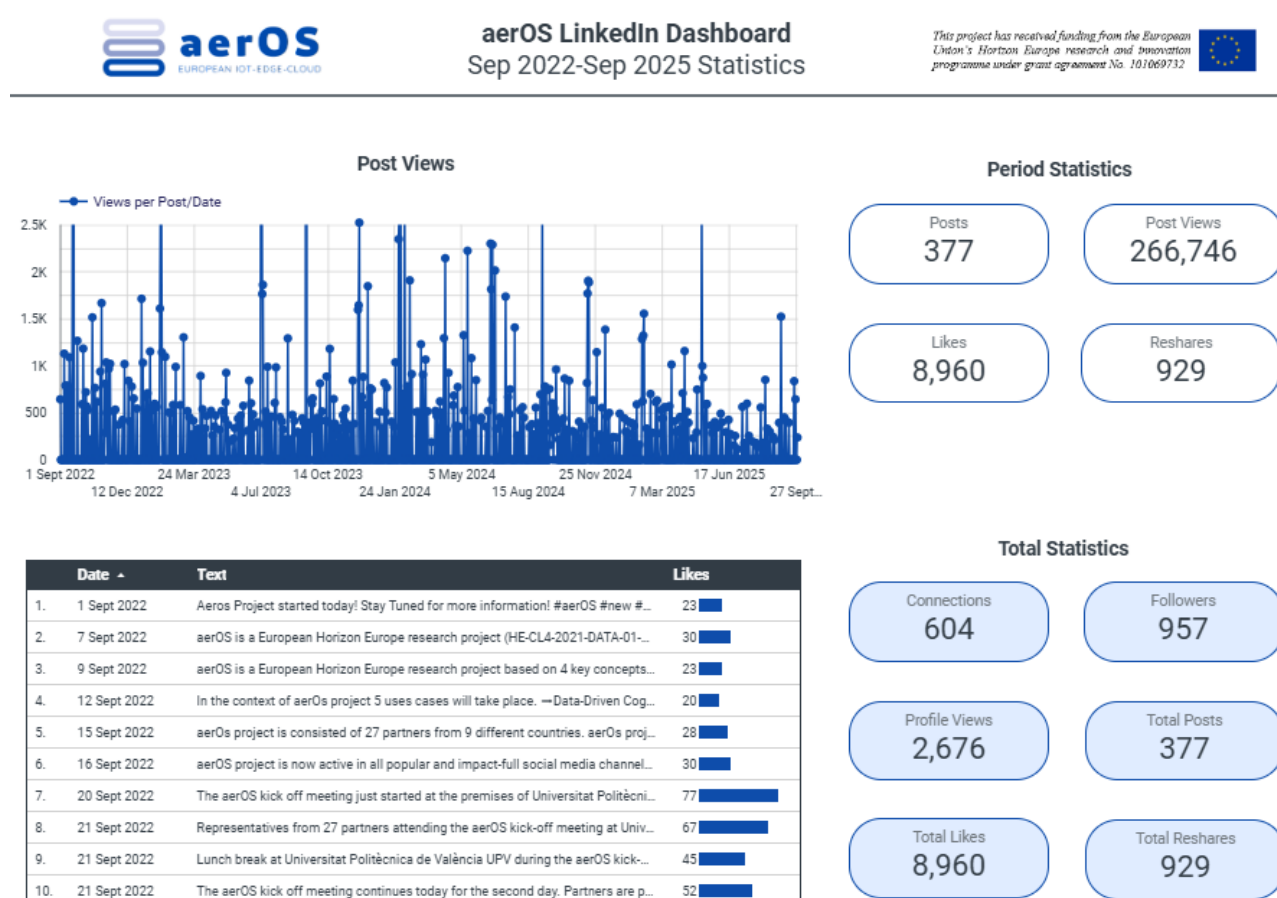


Figure 21 LinkedIn dashboard

Table 8 reports the statistics of the aerOS LinkedIn channel (M1-M37).

Table 8 LinkedIn stats

Posts	377
Connections	604
Followers	957
Profile Views	2,676
Likes	8,960

To provide a better understanding of the LinkedIn channel management, we provide a table with the most impactful posts in terms of LinkedIn likes. **¡Error! No se encuentra el origen de la referencia.** shows the posts which earned the most likes in this 16-month period. As we can see the most “powerful” likes are the ones that are related with face-to-face meetings/activities of the project such as kick-off and plenary meetings.

2. X (Former Twitter) Dashboard

INFOLYSiS team developed a detailed X Dashboard in Looker Studio, which builds upon the previously mentioned metrics. Key indicators displayed in the dashboard include the total number of tweets (412) and retweets (815), along with other relevant performance data. The "Total Statistics" section offers a comprehensive overview of the Twitter account since its launch, showing metrics such as the number of followers (296) and accounts being followed (256).

For further exploration, the X Dashboard for aerOS during the period of September 2022 to September 2025 can be accessed through the following link: <https://lookerstudio.google.com/u/0/reporting/206ddf8e-b1c1-4d6f-ab27-2557cddce27e/page/4YFqB>

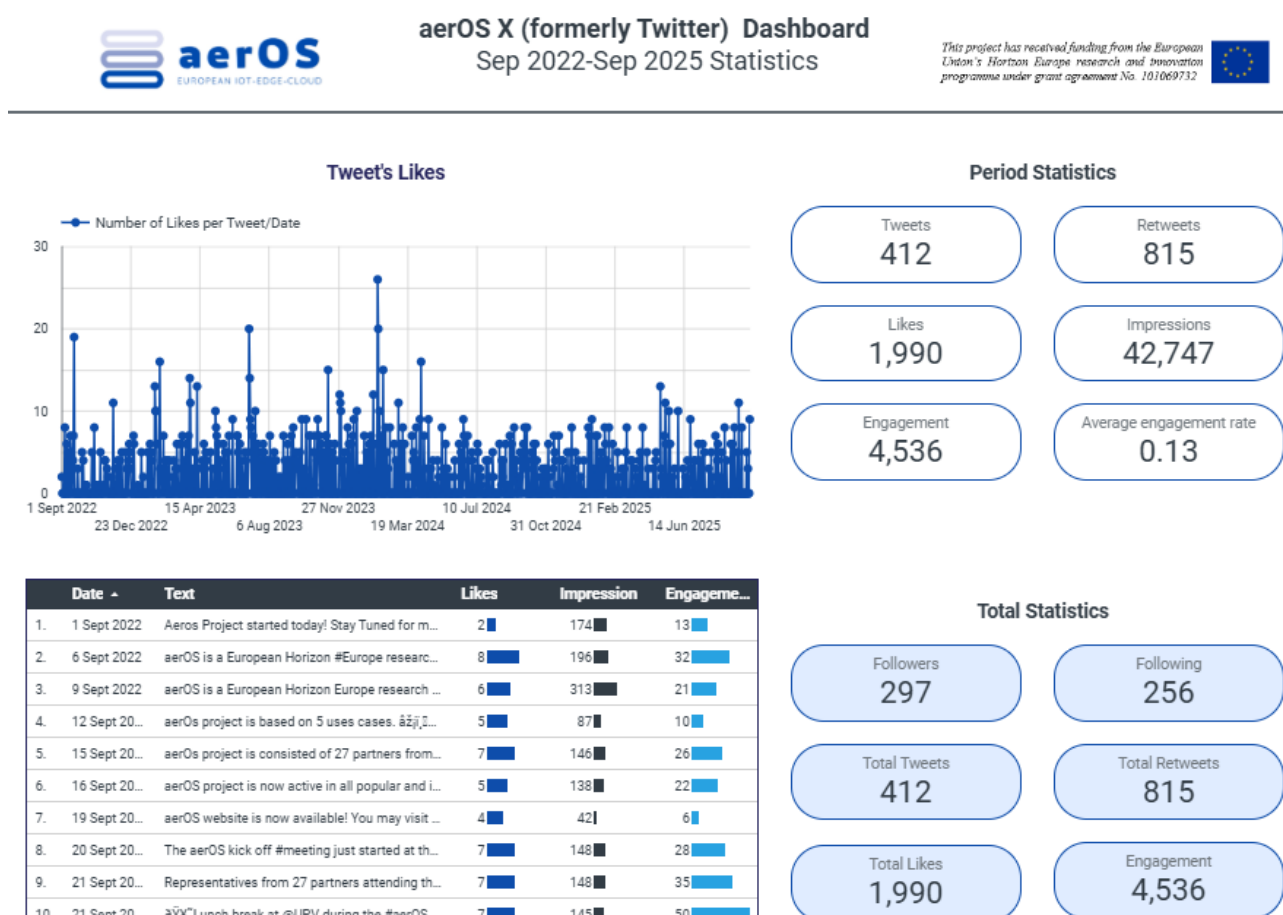


Figure 22 X dashboard

Table 9 reports the statistics of the aerOS X channel (M1-M37).

Table 9 X stats

Tweets	412
Followers	296
Retweets	815
Likes	1,990

3. Facebook Dashboard

The Facebook Dashboard provides users with data for the selected period, showcasing period-specific statistics that highlight key performance indicators (KPIs) relevant to that timeframe. Significant metrics include the total number of posts (359) and page reach (11,863). The Total Statistics section, which spans the entire project duration, offers an overview of overall performance, including the number of page followers (106) and cumulative post likes (1,575).

For a detailed overview of Facebook analytics for the period of September 2022 to September 2025 (Figure 23), the dashboard is accessible online at: <https://lookerstudio.google.com/u/0/reporting/9f4116b8-0c5d-4532-9ef0-32974b4dfa15/page/j5mpB>

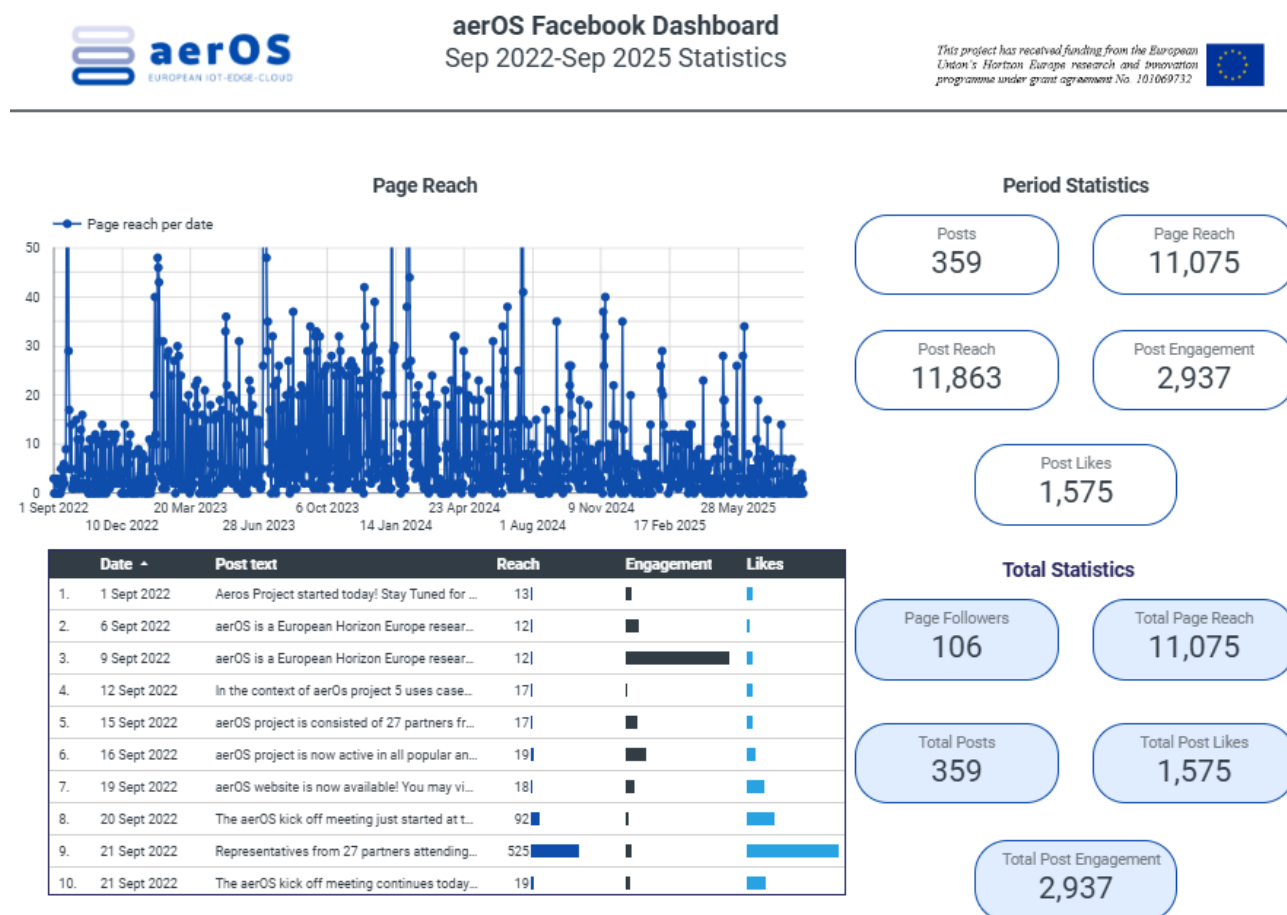


Figure 23 Facebook dashboard

Table 10 summarizes the Facebook activity for the 37 months of the project durations.

Table 10 Facebook stats

Posts	359
Page Followers	106
Post Likes	1,575
Total Page Reach	11,075

4. Instagram Dashboard

The Instagram Dashboard also provides relevant statistical and performance information. The dashboard also includes a line chart with the impression and reach per post and also a table with the number of likes per post over time.

In the following link one may access the aerOS Instagram Dashboard for the period of September 2022 – September 2025:

<https://lookerstudio.google.com/u/0/reporting/13866234-b749-4b2b-81bc-cdd35134eb4a/page/rKQqB>

During the reporting period (M1-M35), the aerOS Instagram account has collected 1,478 total likes, from total of 343 posts. It has gained at these four months 130 followers and 496 profile visits. It has also a total reach of 9,928 (Figure 24).

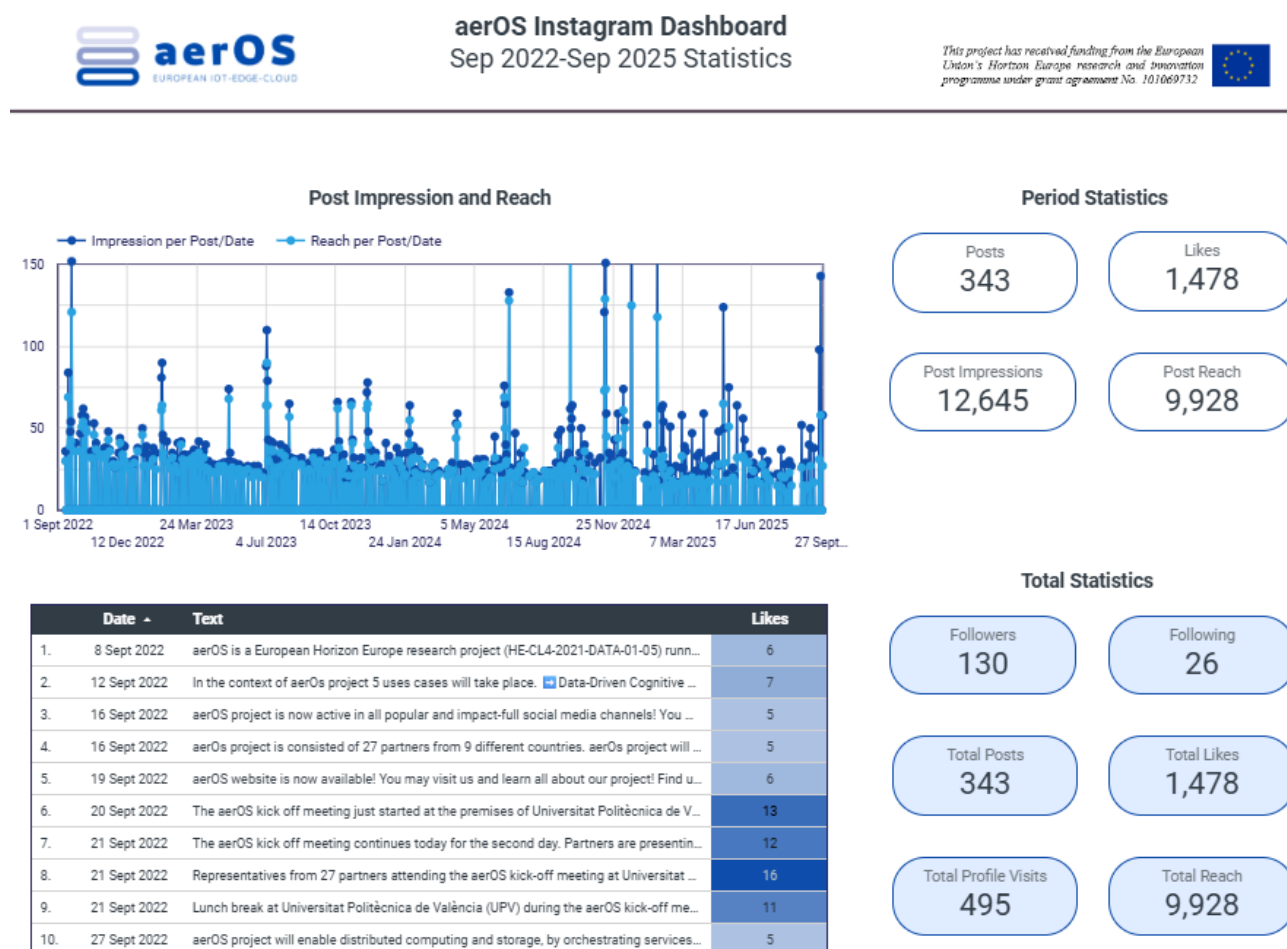


Figure 24 Instagram dashboard

Table 11 summarises the fundamental Instagram insights for this reporting period.

Table 11 Instagram stats

Total Posts	343
Total Likes	1,478
Total Reach	9,928
Followers	130
Total Profile Visits	495

2.1.5. Liaison with EUCloudEdgeIoT, other associations and projects

The EUCloudEdgeIoT association unites projects within the IoT and metaOS domains, aiming to advance understanding and development across the Cloud-Edge-IoT (CEI) Continuum. Its mission is to foster collaboration among research initiatives, developers, suppliers, business users, and potential adopters of this emerging technological ecosystem. To support this, the initiative provides multiple communication and dissemination opportunities.

Each participating project, including **aerOS**, is featured on the EUCloudEdgeIoT website (<https://eucloudedgeiot.eu/members/european-research-and-innovation-projects/>), while project updates are regularly shared through the **EUCloudEdgeIoT News Digest** (<https://eucloudedgeiot.eu/news-digest-new/>).

A key mechanism for community building and knowledge exchange is the **monthly Task Force 6 calls**, organized under EUCloudEdgeIoT's coordination. These sessions enable representatives from all participating projects to present results, share insights, and encourage collaboration.

Below is a tentative summary of **aerOS**'s participation in EUCloudEdgeIoT activities:

- EUCloudEdgeIoT Task Force 6 meetings: 23 meetings,
- aerOS presented in EUCloudEdgeIoT Newsflash issues: 10 times/issues,
- aerOS contributions to EUCloudEdgeIoT White Papers: 10 white papers,
- aerOS promoted through EUCloudEdgeIoT Website (News posts, articles etc.): > 10 news posts,
- aerOS Presentations in EUCloudEdgeIoT events: 10 presentations,
- EUCloudEdgeIoT Events attended/participated: 15 events.

aerOS project has collaborated with other projects and organisations such as SNS (<https://smart-networks.europa.eu/>), Hipeac (<https://www.hipeac.net/#/>), Cyberwatching.eu platform (<https://www.cyberwatching.eu/>), Big Data Value Association (<https://www.bdva.eu/big-data-value-association>), SME Working Group (<https://www.networld-europe.eu/sme-wg/>) and sister cluster projects or SNS ones such as Nephele and SAFE-6G. A tentative list of collaborations between aerOS and these organisations and projects is the following one:

- aerOS project is featured in the Hipeac Info Magazine, October 2023. You may find the magazine online here: <https://www.hipeac.net/magazine/7166.pdf>,
- aerOS participated in the Hipeac Conference 2024 (<https://aeros-project.eu/2024/01/15/aeros-at-hipeac-event-2024/0>),
- aerOS is featured in the Cyberwatching.eu platform (<https://www.cyberwatching.eu/projects/3475/aeros>),
- aerOS & DataPorts collaboration announcement (<https://dataports-project.eu/newcollaborations-with-other-projects/>),
- aerOS Presentation in Big Data Value Association – BDVA (<https://aeros-project.eu/2023/11/15/big-data-value-forum-2023/>),
- aerOS and SAFE-6G collaboration (<https://www.facebook.com/photo/?fbid=510637688443729&set=pcb.510637808443717>)
- AIOTI Days 2025 (<https://aeros-project.eu/2025/07/29/aioti-days-2025/>)
- aerOS participates in the IoT Tech Expo Europe 2025 (<https://aeros-project.eu/2025/07/07/iot-tech-expo-europe-2025/>)

It is important at this stage to mention that the above-mentioned list is a tentative one and it is used for highlighting the collaborations of our project with different organisations and projects. In the future, more collaborations may occur in the aerOS concept.

2.1.6. aerOS Open Call #2 – OC Communication plan – Targeted Communication

The 2nd aerOS Open Call was a cornerstone activity for the continued success and uptake of the aerOS platform. Building on the experience from the first open call, the communication plan was adapted to ensure maximum visibility and engagement. The open call was structured into three phases: the announcement phase (July 2024), the main submission phase (July–September 2024), which focused on attracting high-quality proposals from new sectors, and the results communication phase (October 2024), dedicated to reporting and promoting the selected projects. To support a consistent communication strategy, a dedicated webpage (<https://aeros-project.eu/open-call-2/>) was launched, providing stakeholders with all relevant information, including the open call timeline, objectives, funding, eligibility criteria, and submission process. The webpage also offered easy access to key documents through four main sections: the proposal template, guide, collaboration agreement, and the submission form/process downloading/accessing related material and forms (the template, the guide, the collaboration agreement and the submission button/process) (Figure 25).

Administrative (and other) criteria are as follows:

- Proposals must be written in English in all their parts in order to be eligible.
- The applicants must base their proposals on original work and, going forward, any foreseen developments should be free from third party rights, or they are clearly stated in a specific section.
- Applicants are not allowed to submit multiple applications. If that is the case, only the first submitted application will be considered.
- No entity with economic interest, family or emotional ties or any other shared interest ('conflict of interest') towards aerOS Consortium partners will be accepted as candidates for funding.
- All cases of conflict of interest will be assessed case-by-case, based on pertinent EU stipulations.

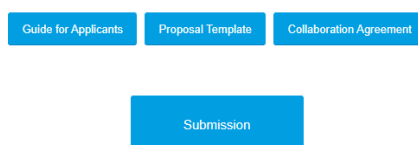


Figure 25 Open Call buttons

In the bottom of the open call webpage, we have created a separated section for the evaluators. This section worked as an express of interest for potential evaluators. Also, a dedicated button with guidelines was created for facilitating the process (Figure 26).

Guidelines for becoming aerOS Open Call Evaluator

Are you a professional or expert interested in becoming aerOS Open Calls evaluator?

For applying to be an evaluator of aerOS Open Calls, the candidates **must submit via email** to the address iglaub@upv.es the following documentation **before September, 15th, 2024, 5pm CEST**.

Please carefully read [the Guideline of Evaluators](#) for the application process details.

Figure 26

Apart from the dedicated open call webpage, INFOLYSiS team, in collaboration with UPV, has created a special Open Call frequently asked questions (FAQ) Webpage (<https://aeros-project.eu/open-calls/open-call-faq/>) (Figure 27).

^ FAQ#1: What is aerOS?
^ FAQ#2: What is aerOS Open Call #2?
^ FAQ#3: Could I apply to aerOS Open Calls?
^ FAQ#4: How could I apply to the funding?
^ FAQ#5: Is there a checklist of steps to be conducted?
^ FAQ#6: Which activities qualify for financial support?
^ FAQ#7: How many applications could I submit?
^ FAQ#8: Which are the evaluation criteria that will be applied?
^ FAQ#9: How would I be joining the project?
^ FAQ#10: How amount of funding can be requested and which are the eligible costs?
^ FAQ#11: Which should be the duration of the project?
^ FAQ#12: When will I find out whether the proposal has been accepted?
^ FAQ#13: Could I be eligible for the 2nd round of Open Calls if I have already received funding in the first round of Open Calls?
^ FAQ#14: Which will be the differences between Open Call #1 and Open Call #2?
^ FAQ#15: Who can I contact to get more information about the Open Call?

Figure 27 FAQ section

On the dedicated webpage, interested stakeholders could find answers to frequently asked questions that arose while preparing proposals. The communication plan for the 2nd Open Call went beyond the website updates. To ensure maximum visibility, additional channels were leveraged, particularly social media. From the announcement of the Open Call (July 2024) until its closing (September 2024), the project's social media accounts were regularly updated with posts highlighting key Open Call details, aimed at engaging a wide and relevant audience. To foster a sense of community, posts included related hashtags such as #aerOSOpenCall2 #opencall and mentioned relevant organizations and other projects with similar calls, including HiPEAC and EUCloudEdgeIoT. To enhance the visual identity of the Open Call, the INFOLYSiS team produced a series of branded images and a short promotional video, designed for social media, that summarized all key information in an accessible and engaging format (Figure 28).



Figure 28 aerOS Open Call image

In addition to social media activities, several presentations at different events were conducted to inform and attract potential candidates. The 2nd aerOS Open Call was presented at multiple webinars organized by the project (<https://aeros-project.eu/2024/09/02/aeros-open-call-2-webinar-series/>). Additionally, the Open Call

leveraged several mailing lists to reach a broad audience, including those of EUCloudEdgeIoT, HiPEAC, SNS, SME WG, and 5GPPP, ensuring wide dissemination of the opportunity.

Last but not least, the open calls from both Open Calls were announced at the website in the following links:

1st Open call: <https://aeros-project.eu/open-call-1-winners/>

2nd Open call: <https://aeros-project.eu/open-call-2-winners/>

2.1.7. Communication activities during the second period (M19-M37) and KPIs

The following Table 12s summarises the set of KPIs and the activities performed during M19-M37 (the total project communication results are presented in Section 2.3 further below). It is important to highlight that **the KPIs presented are cumulative from M19 up to M37 and refer to period 2 performance exclusively..** The period M19–M41 covers the second half of the project’s duration. Overall, communication activities remained on track, and in several cases, the set targets/KPIs had already been achieved or even exceeded before the project’s conclusion.

Table 12 T6.1 KPIs timeline

KPI#	KPI	M12	M24	M36	Activities/Values M19-M37
KPI 3.1.1	# of Website unique visitors / page views	750/2000	1500 / 5000	4000/10000	3098/ 4.866
KPI 3.1.2	# of aerOS posts in social networks/ #of newsletters issued	300/4	650/8	1000/12	836/ 6
KPI 3.1.3	# of aerOS social-media community members across all-sites	300	700	1000	1237
KPI 3.1.4	# of videos delivered about aerOS technical and global advances / webinars-workshops organised	5/1	12/3	20/6	30/ 21
KPI 3.1.5	# of interviews/articles/press releases with external relevant dissemination targets	5	10	30	9
KPI 3.1.6	# of liaison with other projects of the cluster including CSA events	5 actions	20 actions	35 actions	>60

2.2. Updated communication plan and final communication events

The following chapters summarize the communication plan and the related KPIs for the period up to M38, as updated and applied during the second half of the project.

2.2.1. Communication framework of the project

This section outlines the communication action plan, along with the fundamental principles such as timelines, phases, activities, and utilized resources for ensuring successful and impactful communication across various channels and targeted audiences within the aerOS project. The plan encompasses a comprehensive and meticulously structured set of actions aimed at promoting and effectively communicating the developed concepts, technologies, pilots/trials, and overall project outcomes. It encompasses both offline and online communication strategies, digital presence enhancement, event organization and participation, engagement with EUCloudEdgeIoT and NGIoT associations, collaboration with pertinent national/local initiatives, and involvement in other European research and innovation ventures (Figure 29).

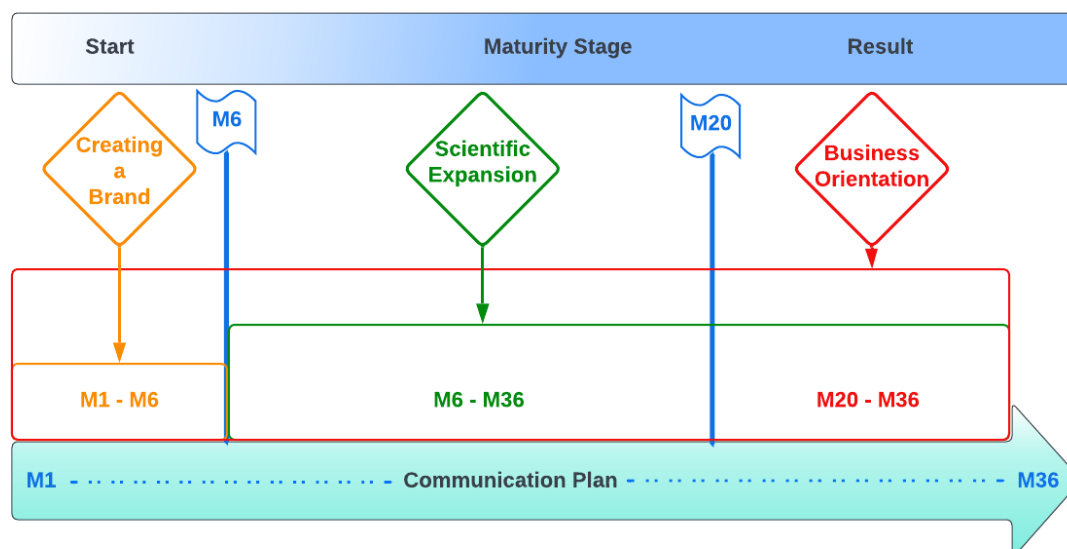


Figure 29 General aerOS communication plan

Stage 1 - Creating a Brand (M1-M6): As it can be clearly seen from **¡Error! No se encuentra el origen de la referencia.** the main focus of the activities during the first months of the project (current period of the project) is to lay the foundation of the communication plan and establish the project's digital presence (raise awareness) by creating communication channels and performing initial impact activities. The first and most significant step in project image/branding is the establishment and maintenance of a website and social media channels, as well as the utilization of the project's logo and the definition of communication guidelines. Other activities, such as the poster, leaflet, newsletter and press release templates, have been created during this first period.

Stage 1 measures: Logo, visual and corporate identity messages and tones for each audience, production of digital communication materials, setup of aerOS social media channels, selection of tips and timeline for posting, aerOS webpage and presence in blogs, promotional material, templates (deliverables, presentations, newsletter, press release) – All completed by M3.

Stage 2 - Scientific Expansion (M6-M38): The main focus of the communication activities in the second period (M6-M38) shifts to actions that connect the nature of the project with the community. The primary goal is to reach the broadest possible audience and identify new essential stakeholders. In other words, the actions focus on establishing a connecting point with the community and the industry by addressing a larger audience and describing how the project may be exploited by specific communities, industry stakeholders, and society in

general. As a result, the communication material/content will be more focused on the project's preliminary technical details and results on specifications, architecture, components, use cases etc.

Stage 2 measures: Supporting the organisation of and participation in conferences, networking, communication campaigns aligned with the objectives and execution pace of aerOS work packages and tasks.

Stage 3 - Business Orientation (M20 – M38): The third period of this plan focuses on communicating (in parallel to dissemination) project findings. Results from use cases and demonstrations will be revealed. As a result, the communication team's main objective will be to outline and promote them through dedicated channels using means for reaching the appropriate target audience and achieving maximum impact. For that reason, the main content that will be communicated, will be focused on the use cases final advances, tests and outcomes of the project.

Stage 3 measures: Enhances interaction with external members such as potential stakeholders and the Advisory Board, common strategy with European initiatives to promote among end users, intensify the presence in industrial events, alignment with dissemination/exploitation/innovation actions, intense communication of final dissemination events, showcasing and trials.

aerOS project establishes a strong communication policy based on its social media channels. Social media channels are a powerful tool to help us to achieve maximum visibility and reach maximum impact.

As previously stated, the primary objective of the aerOS communication plan is to enhance project visibility and raise awareness among a diverse audience, encompassing both technical and non-technical individuals. This was achieved by delivering tailored materials to specific target audiences at appropriate times through suitable channels. Moreover, the content is and will be customized according to the needs and expertise of each audience group and aligned with the project's communication stages. Additionally, the frequency and depth of communication varied, correlating with the distinct phases of the project, including activities, milestones, and outcomes, as well as the utilization of different communication channels.

As it can be clearly understood from the previous section (0), the main two objectives for the second period was on the one hand to reach the broadest possible audience and identify new essential stakeholders, and on the other hand the communication of projects findings and use case results. The second reporting period had this double nature as it included two different levels of the communication plan. The second period also included the scientific expansion of the project but also the business orientation of the aerOS results.

2.2.2. Final Communication Events

2.2.2.1. IoT EXPO 2025

To highlight a landmark event before aerOS end, aerOS project proudly participated in the IoT Tech Expo Europe 2025, held on September 24–25 at RAI Amsterdam, alongside fellow Horizon Europe initiatives—FluidOS, ICOS, NebulOuS, NEMO, and NEPHELE. Together, these projects form a collaborative Meta-Operating System (metaOS) ecosystem, aiming to redefine the edge–cloud continuum across various sectors, including manufacturing, mobility, energy, smart buildings, agriculture, and media.

At the expo, aerOS showcased its open-source Meta-OS, designed to enable secure, flexible, and vendor-neutral orchestration of computing resources across the edge–cloud continuum. This participation underscored the project's commitment to simplifying distributed computing while fostering data autonomy and interoperability across diverse environments and sectors. The collective presence of these metaOS projects at the IoT Tech Expo 2025 highlighted the importance of collaboration in advancing next-generation technologies. By sharing insights, demonstrations, and real-world applications, the projects contributed to shaping the future of European digital infrastructure and promoting a resilient, scalable, and open-edge ecosystem.



Figure 30 Iot EXPO 2025

2.2.2.2. aerOS Final Event

The **aerOS Final Event**, held on **15 October 2025** at the **Ciutat Politècnica de la Innovació (CPI), Universitat Politècnica de València (UPV)**, in Spain, marked the formal conclusion of the aerOS project's multidisciplinary effort to advance the actions and initiatives around **European IoT-Edge-Cloud continuum**. The event brought together researchers, industry stakeholders, and policy representatives to disseminate the project's outcomes and reflect on its scientific and technological contributions to next-generation metaOS activities.

The programme featured **keynote lectures**, **live demonstrations**, and **interactive Q&A sessions**, providing a comprehensive overview of the project's innovations in orchestrating interoperable, intelligent, and secure edge-to-cloud infrastructures. Through these sessions, participants examined the architecture and operational frameworks developed under aerOS to facilitate seamless integration across the computing continuum.

This final event served not only as a dissemination platform but also as an academic forum for interaction on the future of digital ecosystems in Europe. By consolidating its research achievements and fostering cross-sectoral collaboration, the **aerOS project** contributed substantially to the realization of a smarter, more resilient, and sustainable digital landscape.



Figure 31 aerOS Final Event

2.3. Communication KPIs for full project period (M01-M37)

The following table summarizes the communication KPIs values for the full project period. It also provides information about the KPI targets at M24 and M38.

Table 13 T6.1 KPIs for M19-M38 period

KPI#	KPI	M24 Target	M38 Target	Final KPIs (M1-M37)
KPI 3.1.1	# of Website unique visitors / page views	1500 / 5000	4000/10000	7.147/20.706
KPI 3.1.2	# of aerOS posts in social networks/ #of newsletters issued	650/8	1000/12	1491/11 (+1 under editing)
KPI 3.1.3	# of aerOS social-media community members across all-sites	700	1000	2096
KPI 3.1.4	# of videos delivered about aerOS technical and global	12/3	20/6	49/35

	advances / webinars-workshops organised			
KPI 3.1.5	# of interviews/articles/press releases with external relevant dissemination targets	10	30	30
KPI 3.1.6	# of liaison with other projects of the cluster including CSA events	20 actions	35 actions	>60

Table 14 provides a **detailed summary of the collective impact generated across aerOS communication channels during the full project duration**, aligning with the established aerOS communication plan and strategy. This table provides information up to M37, which is the month that we have accumulated data from the statistical dashboards presented in previous sections.

Table 14 Summary of impact content shared over communication channels

Media	Channel – Section	URL	Activity (M37)
Websites	News	https://aeros-project.eu/blog/	Website News Posts >148
	Publications	https://aeros-project.eu/dissemination/publications/	47 publications 14 workshops
	Workshops/ Presentations / trials	https://aeros-project.eu/dissemination/workshops-presentations-trials/	77 presentations of all types
	Articles	https://aeros-project.eu/dissemination/articles/	16 articles
	Press Releases	https://aeros-project.eu/dissemination/press-releases/	11 press releases
	Events	https://aeros-project.eu/dissemination/events/	>58 events attended
Social Media	Facebook	https://www.facebook.com/aerosproject	377 posts and 106 followers
	LinkedIn	https://www.linkedin.com/in/aeros-project/	377 posts and 957 followers
	X	https://twitter.com/AerosProject	412 tweets and 297 followers
	Instagram	https://www.instagram.com/aerosproject/	343 posts and 130 followers
	YouTube	https://www.youtube.com/@aeros-project	49 videos and 89 subscribers
Leaflets		https://aeros-project.eu/dissemination/	1 aerOS leaflet and 8 dedicated pilot leaflets
Posters		https://aeros-project.eu/dissemination/	1 poster & 8 Dedicated Pilot Posters/rollups
Newsletters		https://aeros-project.eu/dissemination/newsletter/	11 issues + 1 under editing
Stickers			>500 stickers
T-shirts			40 t-shirts

3. Dissemination activities, project showcasing and industrial demonstrations

In the second period of the project, aerOS consortium has actively worked to achieve the KPIs for this task. The scope of this section is to provide details about task 6.2 in the second half of the project.

Dissemination activities focus on sharing project results, once they are available, with relevant audiences. Therefore, there are always more dissemination activities in the second half of the project than in the first one, because the project results are available towards the end. The dissemination task has a strong link to the communication task (6.1) which supports dissemination through its communication channels. Some activities of the consortium can be classified both as dissemination and communication. This is also a point of strong cooperation between tasks 6.1 and 6.2 to identify such activities and agree on their proper classification.

Dissemination in aerOS is carried out through publications, events and educational activities to transfer knowledge/results and to enable their uptake. The workflow focuses on informing researchers, industry, potential customers and other stakeholders (e.g. device or software end-users or e.g. associations, policy makers, etc.) about the technical achievements of aerOS and about the benefits from their implementation in different applications.

As we have five pilots in the aerOS project, we put a strong focus in this task on industrial demonstrations. We link all project showcasing activities with one or more industrial demonstrations (one or more use cases to be presented).

As a research and innovation action, aerOS puts a large effort into scientific publications – all research partners are encouraged to write project-related scientific publications, preferably with Open Access, or alternative, according to their possibilities.

As presented in the previous deliverables, we have decided to split the dissemination task into the following core activities:

- Leading edge articles and papers suitable for publication in high-impact scientific journals, and web-based media.
- Demonstration events to showcase the results e.g., promoting aerOS concept and methodology, use cases, acquired knowhow, incl. also talks/panels at relevant international conferences, workshops, technical events, industrial forums, and cooperation with EU stakeholders.
- Educational activities such as university courses, lectures, and activities for PhDs.

The consortium continued to use the “Dissemination Register”, where each partner is responsible for recording the project-related publications and other dissemination activities. On a regular basis, the information is transferred by TTTech to the corresponding SEDIA (Single Electronic Data Interchange Area) tables online. At M38, all publications and dissemination activities completed are duly recorded in the register and in the EC Portal. The submitted papers are also circulated within a consortium. All authors are requested to add the note regarding the aerOS funding in their publications as this:

“This research work is (partially) supported by the European Union’s Horizon Europe program for Research and Innovation through the aerOS project under Grant No. 101069732.”

The publications are also publicly available on the project website at <https://aeros-project.eu/dissemination/publications/>

Figure 31 below shows dissemination activities as recorded in EU Portal:

Dissemination Activities

☐ There is no dissemination activity for this project yet
 List the dissemination activities carried out in the context of the project.
 Include dissemination activities mentioned in the proposal and new ones.

Dissemination Activity Name	What? Type of dissemination activity	Who? Target audience reached	Why? Description of the objective(s) with reference to a specific project output (max 200 characters)	Status of the dissemination activity	Actions
3rd International Workshop on Advances on Privacy	Conferences	Research communities	an aerOS co-organised workshop primarily for Cybersecurity pi	Delivered	✗
IAADE Competence Center Industry 4.0	Other	Investors	To show IAADE Competence Center's facilities and uses cases f	Delivered	✗
7th Workshop on Internet of Things - Enablers, Cha	Other scientific collaboration	Research communities	The WS is current implementation efforts; research results, as	Delivered	✗
Publication of the project on the website	Other	Industry, business partners	To show IAADE Competence Center's involvement in the projec	Delivered	✗
The Autonomous	Conferences	EU Institutions, Industry, business partners, Innovators	At the annual "The Autonomous" conference, the TTTech tear	Delivered	✗
4th International Conference on Electrical and Ele	Conferences	Research communities	Keynote presentation presenting the aerOS general approach	Delivered	✗
Webinar organised by EUCIC T4	Clustering activities	Research communities	To very briefly present the Open Calls of aerOS (1st round)	Delivered	✗
INCOGITO B SECOND Summer School	Education and training events	Specific end user communities	Dissemination of the project's scope and objective in student	Delivered	✗
NEXUS: Where Navara meets Europe	Conferences	Research communities, Industry, business partners	The main objective is to present aerOS' core goal and architec	Delivered	✗
IEEE 117	Other	Industry, business partners	Presentation during NMRG session. Sharing aerOS data fabric i	Delivered	✗
International Workshop on Embedded Digital Intell	Other scientific collaboration	Research communities	The technical scope of IWED included the following topics: i	Delivered	✗
IOT Expo 2023 Köln	Other	Industry, business partners	IOT Expo is an annual international exhibition that showcases t	Delivered	✗
Informative Session on Horizon Europe Work Program	Collaboration with EU-funded projects	Other	We will expose the project's architecture and goal to foster ir	Delivered	✗
Webinar of aerOS about Open Calls	Clustering activities	Research communities	To present the Open Calls of aerOS (1st round)	Delivered	✗
Dependable Systems university course - 01/2023	Education and training events	Specific end user communities	This course is run by Dr. Wilfried Steiner at the Vienna Univer	Delivered	✗
Program mobile robots with Low-Code tools	Education and training events	Specific end user communities	Challenge if Low-Code tools are up for the task to do automati	Delivered	✗

Figure 31 Screenshot from EU Portal showing the recorded dissemination activities (selection – full list cannot be displayed)

Additionally, Figure 32 shows publications as recorded in the EU Portal:

Type	Title	Authors	Title of the journal or equivalent	Number	Peer-reviewed	Was the publication available in open access through the repository at the time of publication	PID (publisher version of record)	PID of deposited publication	Actions
2	Article in Journal	AI/ML Service Enablers & Model A	K. Sanderis, A. Hatt Al-Bou, J. So	IEEE Network Magazine	True	True	10.1109/INMET.129.2200417		✗
3	Article in Journal	Berth Allocation Considering Mult	Shoraz Adnan, Michael R. Michael	Journal of Marine Science and En	2023, 11(7), 1280	True	10.3390/jmse11071280		✗
4	Article in Journal	Cloud-Native Workload Orchestrat	Rafael Valio, Ignacio Lacalle, Piotr	MDPI Sensors	2023, 23(4), 2215	True	10.3390/s23042215		✗
5	Article in Journal	Heterogeneous Edge Caching bas	C. Wang, R. Li, X. Wang, T. Taleb, I	IEEE Transactions on Network Sci	True	True	10.1109/THNS.2023.1260882		✗
6	Article in Journal	IDADET: Iterative Double-sided Au	Y. Xu, H. He, J. Liu, Y. Shen, T. Ts	IEEE IoT Journal	True	True	10.1109/JOT.2023.1236968		✗
7	Article in Journal	Novel Combinatorial Multi-Armed I	Z. Shu, H. Feng, T. Taleb, and Z. Z	Elsevier Computer Networks	True	True	10.1016/j.comnet.2023.109783		✗
8	Article in Journal	Probabilistic-Assured Resource Pr	Q. Guo, R. Gu, H. Yu, T. Taleb, an	IEEE TNSM	True	True	10.1109/TNSM.2023.1219865		✗
9	Article in Journal	Self-Capabilities of heterogeneous	Raul S-Julian, Ignacio Lacalle, Rafi	MDPI Sensors	2023, 23(6), 2931	True	10.3390/s23062931		✗
10	Publication in conference proced	Adversarial Machine Learning Att	Pantelakis, V., Bountas, R., Farai	18th International Conference on	True	False	10.1145/3600160.3605086		✗
11	Publication in conference proced	Network Slice Mobility for 6G Net	H. Yu, Z. Ming, C. Wang, and T. Ts	IEEE Int'l Conference on Communi	True	True			✗

Figure 32 Screenshot from EU Portal showing the recorded publications (selection – full list cannot be displayed)

The register has been used also to monitor the dissemination KPIs during the project and eventually propose corrective actions. This approach has been successful in promoting cooperation and transparency in dissemination activities management.

In the next section we will report on the dissemination results of the last period of the project.

3.1. Dissemination in the second period of the project (M17-M38)

In the last period of the project, we have increased the activities towards dissemination of project results. In particular, with respect to scientific publications activity among the partners, 33 scientific publications have been published. Most of the publications have been articles in conference proceedings (19), while there have been 14 publications in journals. Many publications have been done in different IEEE journals such as IEEE Conference on Standards for Communications and Networking (CSCN), IEEE Wireless Communications and Networking Conference (WCNC) and IEEE World Forum on Internet of Things (WF-IoT).

Other dissemination activities have been carried out by partners during the last 18 months. There have been several collaborations with other EU-funded projects and initiatives (such as for example EU Cloud-Edge-IoT, HIPEAC, ENABLE 6G, SAFE6G and others) and clustering activities, aerOS has initiated and organized workshops at conferences, such as VEHITS 2024 conference and FIWARE Global Summit 2025, industry partners presented the project at fairs/industry events, such as IoT Tech Expo 2025, ITS European Congress. and others.

In the last project period, aerOS partners have increased their efforts towards education and training activities, for example project technologies and use cases have been disseminated to university students and PhDs. For instance, SUPSI has organized summer school on “Hands on Industrial IoT: Mastering the Mini-Factory” in July 2024. Also, TTTech's Corporate Scientist Dr. Wilfried Steiner as lecturer of Dependable Systems Course

at TU Vienna, continued to use aerOS to present an example of building dependable computer systems and distributing resources between edge and cloud in the spring semester 2024/2025.

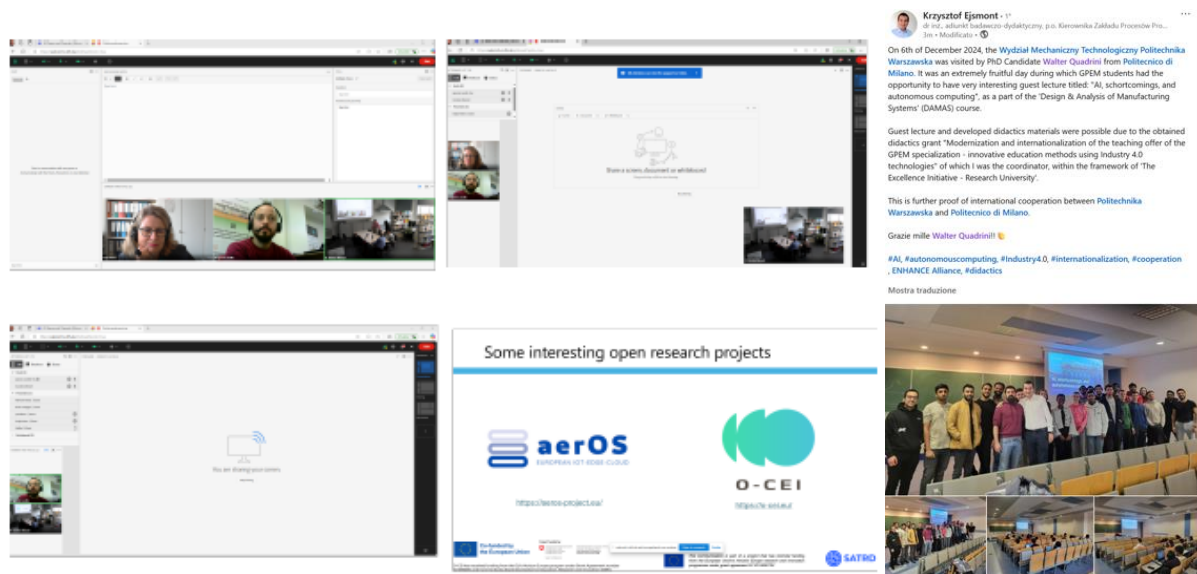


Figure 33 Examples of educational activities from aerOS partners: online seminar to PhD students of TU Dresden and seminar for MSc students in Warsaw University

In table 16, we present the KPIs for dissemination activities. We have achieved and exceeded all the proposed KPIs which demonstrate that we have fulfilled the goals in disseminating aerOS results towards the different target groups. As a note, KPI 3.2.4 was only half achieved according to the planned KPI. However, aerOS partners have organised 18 workshops in conferences and events even though with a lower participation than planned, but overall we reached more than 500 people across the community which is an outstanding result and demonstrated the engagement of aerOS partners in the dissemination activities.



Figure 34 Initial slide of the presentation of aerOS partner, UPV during the Meta-OS cluster event organized at IoT Tech Expo in September 2025 in Amsterdam

Table 15 T6.2 KPIs for the second period of the projects

KPI#	KPI	PLAN for M38	ACHIEVED for M38
KPI 3.2.1	# of scientific papers published in conferences / Q1-Q2 journals	20/8	23/24
KPI 3.2.2	# of activities towards Education institutions (courses, lectures, PhDs)	15	18
KPI 3.2.3	# of presentations and other activities in events/conferences/fairs by aerOS partners	35	77
KPI 3.2.4	# of workshops organized / average participants in each workshop	3/60	18/30
KPI 3.2.5	# of PhD and MSc theses started about aerOS	6	11

NB: please note our calculation method for KPIs:

- # of presentations and other activities in events/conferences/fairs by aerOS partners: educational activities and workshops organized by aerOS are excluded from the count,
- # of workshops organized: only events labeled as such are counted,
- # of activities towards Education institutions (courses, lectures, PhDs): only events labeled as such are counted,
- # of PhD and MSc theses started about aerOS: the target value is 6 theses by the end of the project.
- No entry is counted in more than one KPI category

4. Standardization and policies alignment

4.1. Standardization in the full period of the project (M01-M38) and status of KPIs

As described by the plan laid out in D6.1, the standardization and policy alignment task (T6.3) the aerOS project focussed on exploiting the strong connections that some of the consortium partners maintain with Standardization Developing Organizations (SDOs), and pre-normative groups. These connections are internally referred to as “entry points”. To achieve the most efficient exploitation of entry points, a census was performed among consortium partners, where details of those interactions were described. At the time, the census reported that the consortium attended a total of 24 SDOs and pre-normative organizations, a significant number that has served as a very good starting point to guarantee the impact of the aerOS project in standardization spaces.

4.1.1. Status of KPIs

Task 5.3, namely the KPI definition and setup of evaluation framework for the aerOS project, describes five KPIs related to the impact creation via standardization, those are:

- KPI-3.3.1: Contributions to standardization bodies
- KPI-3.3.2: Exploitation of entry points into standardization bodies
- KPI-3.3.3: Contributions to European pre-normatives
- KPI-3.3.4: Contributions to data-related clusters and initiatives

- KPI-3.3.5: Contributions to relevant data spaces

KPI-3.3.1 refers to measurable and palpable impact to the activities of SDOs, for example proposing amendments, contributing to drafts, providing use cases or specific application scenarios, or even being referenced by SDOs as a showcase for their standards. In contrast to that, KPI-3.3.2 covers all efforts to use the collected information about entry points to SDOs to look for potential impact opportunities. The rest of the KPIs count contributions to specific types of organizations that relate to the technological space of aerOS.

Table 17 shows the planned evolution of those KPIs on the 12th month (August 2023), the 24th (August 2024) and finally the 38th month (August 2025). After that, Table 18 displays the status of those KPIs on the 38th month (October 2025) in comparison with the final target.

Table 16 Planned evolution of KPIs related to impact through standardization activities

KPI#	KPI	M12	M24	M38
KPI 3.3.1	Contributions to SDOs	0	6	12
KPI 3.3.2	Entry points exploited	5	15	25
KPI 3.3.3	Contributions to European pre-normatives	0	1	3
KPI 3.3.4	Contributions to data-related clusters and initiatives	0	5	10
KPI 3.3.5	Contributions to relevant data spaces	0	5	10

Table 17 Current status of KPIs related to impact through standardization activities

KPI#	KPI	Status M38	Final goal (M38)
KPI 3.3.1	Contributions to SDOs	24	12
KPI 3.3.2	Entry points exploited	25	25
KPI 3.3.3	Contributions to European pre-normatives	2	3
KPI 3.3.4	Contributions to data-related clusters and initiatives	4	10
KPI 3.3.5	Contributions to relevant data spaces	10	10

As seen in Table 18 the status of KPIs, for KPI 3.3.1 and 3.3.5, the goal was achieved, for KPI 3.3.2 and 3.3.3, and for KPI 3.3.2 and 3.3.3, the a KPIs close to the target has been fulfilled. The KPI 3.3.4 is at the moment of

writing strongly lacking behind, but as a consequence of the nature of the KPI's topic: As all artifacts of the project will be published at the end of the project together, this also includes artifacts like datasets of the use-cases or the continuum that are the contributions measured by KPI 3.3.4. However, a clear highlighting is that the expected number of contributions to SDOs was strongly overachieved by double the final goal.

Details about the specific activities that are summarized in the status column of Table 18 are provided in the following sections. Section 4.1.2 provides insights into the contributions that have been already catalogued, and represent ongoing efforts that showcase interesting results from the aerOS project in relevant standardization spaces. After that, section 4.1.3 details the steps that have been taken to exploit some of the collected entry-points, apart from the ones described in section 4.1.2.

4.1.2. Standardisation activities(M1-M38)

4.1.2.1. AIOTI (Towards ISO/IEC JTC 1/SC 41)

Especially during the first 6 months of the project but also beyond, there has been an intense activity by aerOS partners involved in the Alliance for Internet of Things Initiative (AIOTI). The main partners of aerOS that overseen delivering this contribution have been SIEMENS and UPV.

The activity has concentrated on showcasing aerOS benefits and progress in several aspects, especially on technical architecture, technological developments, pilot structure and goals and on Open Calls. In most cases, the participation in periodic teleconferences/meetings organised by AIOTI has been leveraged as opportunities to pitch aerOS. In other cases, specific actions such as the issue of specialized reports or whitepapers led by AIOT working groups (WG) have also been tackled.

In particular, the following actions highlight as the main contributions by aerOS via AIOTI initiative. Please, note that these are not the only ones:

- AIOTI HLA – High Level Architecture – Periodic attendance to architecture discussions, ensuring the alignment of aerOS IoT perspective with the directives and recommendations of AIOTI HLA. The activity was mostly focused in the “IoT, edge computing and digital twins” group,
- Participation in the webinar “Webinar: IoT, Cloud, Edge Computing Continuum from Research to Deployment”, 30th November 2022,
- AIOTI Business Forum – aerOS partners participated in this initiative by AIOTI via exposing the demand vs. supply side of meta-Operating Systems,
- Voluntary participation in the preparatory actions of the “Replicability Initiative” for the creation and assessment of the “Feasibility, Replicability and Scalability Assessment Tool”. This ended in a contribution to the AIOTI White Paper Replicability and Scalability Assessment Tool,
- Participation in the Semantic Interoperability Expert Group in January 2023,
- Following and participating in the issuing of SRIA of AIOTI 2023,
- Active contribution in the Working Group of Privacy and Security
- Presentation of aerOS in multiple presentations at AIOTI Days 2024 (24-25 Sept 2024)
- Continuous participation in the WG of Standardization of AIOTI, providing inputs on the current development trends and in the barriers found whenever deploying computing continuum solutions. Within the frame of this WG, and in collaboration with EUCloudEdgeIoT, the most relevant on-going action was born in the inner group (within Standardization WG) of High-Level Architecture of IoT.

While all the previous can be considered “contributions to SDOs” (if AIOTI is deemed as a SDO entity), none of them were qualified to be moved to a pre-normative initiative issuing. However, AIOTI liaised with EUCloudEdgeIoT initiative for moving forward a tentative to standardise the architecture of the Computing Continuum in Europe.

4.1.2.2. EUCloudEdgeIoT

Two Coordination and Support Actions (CSAs) were funded in 2021 to cluster the communication and collaboration of the RIA projects coming out of the DATA-01-02 (cognitive cloud), DATA-01-03 (swarm computing) and DATA-01-05 (meta operating systems). These CSAs were UnlockCEI and OpenContinuum, that started their activity in late 2022. Only a few months in their activity, it was decided for them to join forces (act collaboratively) and follow up on the good job done by their predecessors (i.e., EU-IoT and NGIoT), thus encompassing the advances of many other projects (calls ICT-56-2019, among others). The collaborative action between the two CSAs was born as EUCloudEdgeIoT, whose main objective is to bring together all European research around the computing continuum (and surrounding fields) towards aligning with EC objectives and long-term goals. These goals include standardization.

On the light of this combination, their action was structured in different task forces. Every task force is devoted to a specific area of collaboration interest and is led by one of the entities belonging to the two mentioned CSAs. Task forces (TFs) are: TF1 – Strategic Liaisons, TF2 – Open-Source Engagement, TF3- Architecture, TF4 – Ecosystem Engagement, TF5 – Market & Sectors and TF6 – Communications.

It is within the scope of TF3 where aerOS has focused its contribution during the first half of the project. The main current activity of TF3 is to move forward the creation of a standard to determine the design and deployment of the computing continuum. The goal is to establish the conceptual, technological, methodological and adoption guidelines for the computing continuum, growing upon the experience and success stories of the RIA projects funded by the EC in the abovementioned calls. The ideation of this standard is being tackled as a collective collaborative effort between representatives of the projects, that propose their ideas (drawing from the developments in their projects), that are then debated and agreed thereof.

Ultimately, when this activity will conclude (currently on-going), **it will be transferred into the ISO/IEC JTC 1/SC 41 for including it as an ISO standard**. This link is being reinforced by one of the partners participating in OpenContinuum (TRIALOG), and, when finalised, will have a major impact in the community.

In this regard, aerOS **participated the ISO/IEC JTC 1/SC 41 Plenary Meeting in Helsinki on May 2024**, to present the advances on this standard, and specifically the role of aerOS in it. This is considered an outstanding opportunity for the project to contribute to the most relevant standardization action in the field of computing continuum.

This pre-standardisation action is structured in different working groups, that are defining the concepts and technological blocks that form the computing continuum. A set of images of the current status (Figure 35-37) of definition of those blocks are included below:

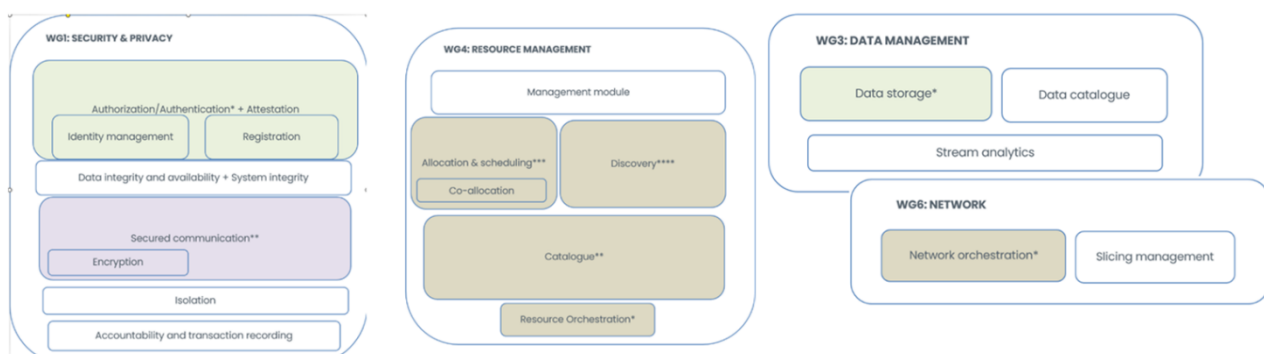


Figure 35 EUCloudEdgeIoT – TF3 – pre-standardisation initiatives – WG1, WG3, WG4 blocks

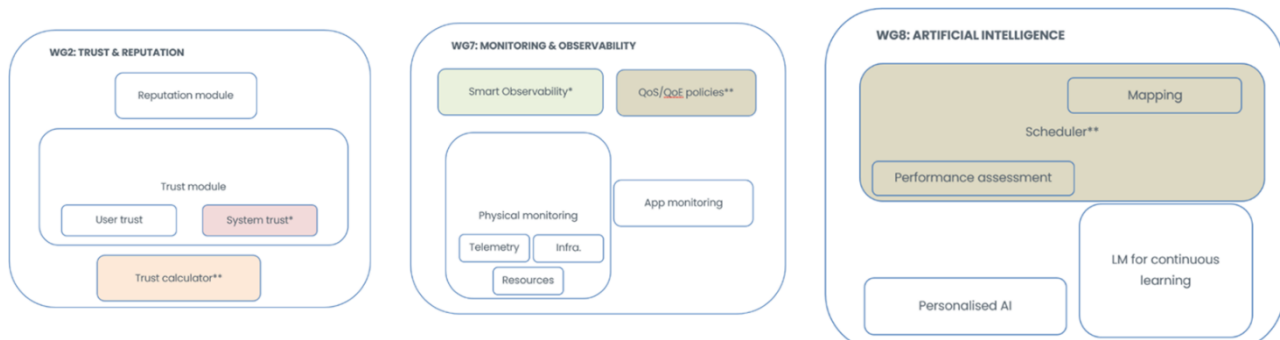


Figure 36 EUCloudEdgeIoT – TF3 – pre-standardisation initiatives – WG2, WG7, WG8 blocks

Remarkably, each of the WG is led by one of the RIA projects. aerOS is leading the Orchestration building block. This way, the project is contributing greatly to the future outlook of the Orchestration block in the to-be standard ISO/IEC JTC 1/SC 41 (Figure 37).

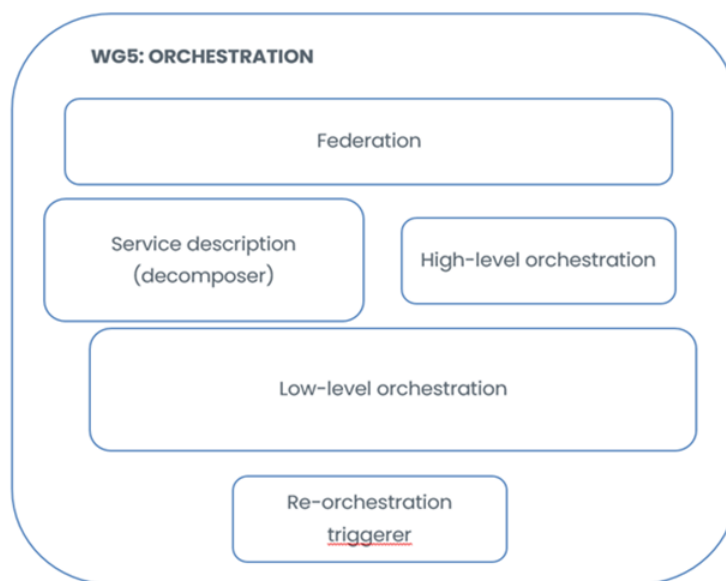


Figure 37 EUCloudEdgeIoT – TF3 – pre-standardisation initiatives – WG5 block

4.1.2.3. ETSI

The standardisation activities conducted by Telefónica Investigación y Desarrollo (TID) within ETSI have targeted the ETSI ISG CIM thus far by extending the NGSI-LD API (ETSI CIM 009) with several contributions in multiple releases.

The OpenAPI specification for NGSI-LD API 1.6.1 has been developed and uploaded to the official ETSI Forge repository [1]. This specification has become the baseline for the next releases of the NGSI-LD API, which will be developed in the Expertise Specialist Task Force (STF) 676 (ISG CIM), starting in January 2024.

In the release ETSI CIM 009 v1.7.1 [2], the data types defined by the NGSI-LD API have been thoroughly refined, identifying inconsistencies in the specification as well as in the documentation following best practices in REST API modelling.

Lastly, in the upcoming ETSI CIM 009 v1.8.1 [3], the NGSI-LD API has been extended to support filtering based on the *datasetId* parameter for read operations. Context Consumers now can directly retrieve only the values of NGSI-LD Properties and Relationships that match the specified *datasetId*. This enhancement unlocks new potential features like “graph views”, where different views or projections of an NGSI-LD Entity can be represented using *datasetId*.

As TID, the FIWARE Foundation is also an active contributor to ETSI ISG CIM, providing a substantial amount of code and improvements to the NGSI-LD API specification. Some ideas coming from aerOS were already implemented by FIWARE in version 1.7.1, those were:

- New type of NGSI-LD Attribute: VocabularyProperty,
- Change of simplified representation in multi-attribute case,
- More detailed aspects to be specified in Context Registrations,
- Defined special NGSI-LD roles for Context Source Registrations,
- Clarifications regarding user @context,
- Add Batch Query to “Federation Ops” group,
- Relaxing of tenant name requirements.

Likewise, some new improvements will appear in the version 1.8.1 that will be released in March 2024, such as:

- Distributed Entities Query, using entity maps,
- Entity graph retrieval (include in the response entities referred via relationships),
- Follow relationship entities in the query language,
- Relationship object as array of URIs, not just a single string,
- Local requests without any other specifier (?local=true),
- New type of NGSI-LD Attribute: JsonProperty (expand values),
- New URL parameters for GET /entities: pick/omit + idsOnly ("pick" deprecates "attrs"),
- New endpoints “/info” + “/info/sourceIdentity”,
- Usage of the Via HTTP header for loop detection in distributed operations.

Ultimately, efforts by Demokritos, UPV, and Siemens have been made to evaluate the potential to create a own working group based on the results of aerOS at ETSI, lead by the consortium partners as a strong opportunity to contribute to ETSI as European standardization body and a promising way to continue to the work of aerOS even after the project. However, during the evaluation phase a conflict was discovered with the open-source strategy of the project with the Eclipse foundation. Therefore, this approach had to be stopped in favour of the open-source strategy. This lead also to the fact that the KPI 3.3.3 was not fully achieved by one missing contribution, as this approach was meant to be the final one.

Finally, aerOS contributed to the ETSI one more time by extending the SAREF core ontology to represent AI applications and predictions, which will be included in the next v4. This effort was done by TID.

4.1.2.4. IETF

TID made the following contributions in different areas and groups of the IETF.

In the IETF IVY group, the Asset Lifecycle Management and Operations: A Problem Statement [4] draft was submitted. This document tackles the lifecycle management of network assets by presenting use cases and defining an information model to support network operator’s work.

In the Ops Area, there has been contributions to improve the provenance and contextual understanding of YANG data. The Applying COSE Signatures for YANG Data Provenance [5] proposes COSE as new mechanism for verifying the integrity and provenance of YANG data. The Data Manifest for Contextualized Telemetry Data [6] draft defines new YANG models that capture metadata related to the network device from which the YANG telemetry data is received, along with the details on the configured subscription to stream of data.

Lastly, in the IETF NETMOD working group, the Mounting YANG-Defined Information from Remote Datastores [7] introduces mechanisms for federating access to YANG data, building upon principles like data virtualization and data integration, which aerOS is following in the implementation of the aerOS Data Fabric for the continuum.

4.1.2.5. IRTF

With regards to IRTF, the research around data management conducted by TID within the scope of aerOS has led to a few contributions to NMRG.

During the IETF 117 event, the presentation “Data Management Paradigms: Data Fabric and Data Mesh” [8] introduced to the network community some of the data management paradigms that aerOS is following, and their potential applicability in network management.

In the following IETF 118 event, the presentation “Knowledge Graphs for Network Management” [9] focused on raising awareness of knowledge graphs. This presentation showed how aerOS is building a knowledge graph based on the ETSI CIM standard for the implementation of the aerOS Data Fabric that provides a uniform access to the data available in the continuum.

4.1.2.6. 5G-ACIA (Towards 3GPP)

SIEMENS is presenting aerOS’ requirements on deterministic communication technologies for the continuum in the Working Group 3 of 5G-ACIA. Some technical requirements have been identified and discussed, such as:

- Determinism across different technology domains. E.g., Ethernet, WLAN, 5G,
- Deterministic and cost-effective establishment of new streams, providing, for example:
 - Online re-scheduling,
 - Timely application of new configurations.
- Standardized and sufficient north-bound interfaces for domain controllers,
- Real-time behaviour of network resources in endpoints hosts.

The intention is to collect views from other partners of the association and generate a liaison statement to 3GPP, for consideration in their upcoming releases.

4.1.2.7. Others

INNOVALIA leverages its leadership position in several data-related initiatives to showcase the impact of the aerOS proposals. For instance, they contribute to the CEN/CENELEC CWA Trusted Data Transactions, sit on the International Manufacturing-X Council (alongside SIEMENS), work on the 5G-PPP Technology Board and participate on the Data Space Support Centre (DSSC). Another contribution done by UPV impacted the Roadmap v5 and beyond of the INSTAR European Task Force Cloud/Edge/IoT by building on the expertise from the aerOS project. Furthermore, an important contribution to European pre-normatives was done by Siemens with presenting the DetNet/5G – Deterministic Programmable Data Planes for the Cloud-Edge-IoT Continuum use case to the 5G-ACIA WI82.

4.1.3. Exploitation of entry points to other SDOs

Apart from the cases already described in 4.1.2, additional efforts have been made during the project to look for potential contribution opportunities into standardization spaces. Some of them already show promising results. Those efforts are summarized in the table below:

Table 18 Summary of exploitation of entry points to SDOs during the first period of the project (Excluding those mentioned in Section 4.1.2)

Entry points	Activities	Potential Contributions	Driving partner	Supporting partners
Smart Data Models	• Presentation to aerOS WP4 partners about how to create	Several data models for the use case of the computer continuum can be standardized.	FIWARE / TID	All participants of WP4

	and submit new Smart Data Models			
	Several technical discussions about required data models			
ISO/IEC JTC 1/SC 41	Arrangement of presentation about aerOS enablers in the ISO/IEC JTC 1/SC 41 Plenary meeting in Helsinki (27.05.2024)	Presenting aerOS as a source of concepts to write ISO standards on the computer continuum	SIEMENS	UPV
Linux Foundation	Presentation of the aerOS project to Siemens' representatives in the Linux Foundation	Positioning of the continuum as a use case for developing features for Meta-Operating Systems	SIEMENS	
IEEE Switchgear Committee	Presentation of the aerOS project to the Chairman of the IEEE Switchgear Committee	Presenting aerOS' vision on energy efficient, health safe and sustainable smart buildings as a use case for the virtualization of control functions for high-power applications	SIEMENS	
W3C	Presentation of the aerOS project to Siemens' representatives in the W3C.	Positioning aerOS' data-related needs in the context of the continuum as requirements for standardization efforts in the area of semantic interoperability	SIEMENS	SRIPAS
INSTAR-TF	Collaboration in the INSTAR-TF description of action: Membership and participation in meetings and in description of scope.	Transfer knowledge, insights and achievements of aerOS to the INSTAR project	UPV	
DISCOVER-US	Membership and attendance to online webinars and opportunities.	Transfer knowledge, insights and achievements of aerOS to the DISCOVER-US initiative	UPV	
StandICT	Participation in regular meetings/telcos (often co-located with AIOTI telcos)	Contributing to the working groups of IoT and Edge by representing aerOS and its results	UPV	

W3C KGC Community group	Representing aerOS to the W3C KGC community group	Transfer knowledge to this community.	TID	
W3C WoT Group	Workshop in AIOTI days with WoT representatives	Showcase aerOS's achievements and results in the context of Web-of-Things and influence further developments with this group	UPV	
INSTAR-TF	INSTAR EU-Canada Standardization Exchange	UPV presented aerOS on the EU-Canada standardization exchange	UPV	
ISO/IEC and others	Presence of ATOS in the final event	Via the linking of ATOS we impact ISO/IEC SC	UPV	

4.1.4. Contributions to data-related clusters and initiatives

For KPI 3.3.5 the goal is to contribute to data-related clusters and initiatives by sharing items like datasets gathered as long as they follow the FAIR principles of data sharings and such contributions that for example share ontologies/smart data models of data. At the moment of writing four contributions have been done. However, there are several data artefacts that will be uploaded in the final sharing of all results of the project. As they have not been completed at this moment, there are not included in this document.

Three contributions have been completed by TID by sharing the ontologies for the orchestration of the aerOS continuum, for the defining concepts of the aerOS Data Catalog, and for the conceptual model for Pilot 5 – Smart building available in this [open repository](#). Another contribution was done by UPV by sharing the NGSI-LD format data model that described the whole continuum which is at the moment still at a incubation phase and can be tracked [here](#).

4.1.5. Contribution to relevant data spaces

In contrast to the previous section about data initiatives, this section focuses on contributions to data spaces. The difference is that a dataspace is the platform or space that leverages the exchange of data between different entities, while a data initiative directly shares data artefacts. Hereby huge activity was shown by the FIWARE partner. This includes development contributions to the ORION-LD in the data spaces of mobility and manufacturing, continuous leverage of blueprints for data interoperability and usage of context brokers within the Data Space Support Center, as well as NGSI-LD contributions for the smart cities data space. Furthermore, FIWARE contributed in multiple recurrent meetings contribution to different fields of the Big Data Value Association, as well of the BAIDATA association, International Data Space Association, Manufacturing-X platform and the CEN-CENELC committees

5. Exploitation Activities, IPR management and innovation

This section reflects on the advances performed in task T6.4 of aerOS since M18 (D6.2). It is divided in three main sections, illustrating (i) the IPR management in terms of assets, identification and Key Exploitation Results description, (ii) exploring the plan for exploitation of results expected by each partner and (iii) proposing a first attempt and the tentative plan for aerOS business analysis. It is accompanied with several complementary tables that can be found in the Annexes at the end of the deliverable.

5.1. Exploitation plan

During the preliminary stage of the project, a deliberate effort was undertaken to gather a wide range of assets from all partners, acknowledging the distinct contributions that each entity could offer to the undertaking. Following this, a critical organizational measure was to precisely classify these accumulated assets into predetermined categories.

A person, group, or corporation that wants to successfully manage and protect its intellectual property assets must design and implement an intellectual property (IP) rights strategy. The term "intellectual property" refers to works of art, designs, trademarks, and other products of the mind that are capable of being legally protected by patents, copyrights, trademarks, and other intellectual property rights.

Background (BG) IP: BG can be outlined as knowledge, expertise, or information held or licensed by a project partner prior to the start of the project and required to carry out the action or capitalize on the project's outcomes. In essence, the term "BG", pertains to assets that a partner has cultivated and possesses before the commencement of the project. These assets encompass pre-existing intellectual property, resources, or strategic advantages that the partner brings into the project, contributing to its overall objectives and success.

Foreground (FG) IP: FG describes the outcomes produced via the execution of project operations, including data, resources, and knowledge. The concept of "FG" encapsulates an evolution from the BG as they are refined and developed within the project's framework. It encompasses both the adaptation and progress of existing BGs as they are applied to the project's context and the creation of entirely new assets or functionalities that emerge as a result of the project's activities.

Exploitable Result (ER): ER, utilizing research findings for purposes other than those covered by the activity in question, developing, producing, and selling a product or process, producing and offering a service, or engaging in standardization efforts are all examples of exploiting project outcomes. In simple terms, an exploitable result represents an asset or outcome generated within the project that holds value and utility beyond the project's timeline. These results are intended for post-project utilization, reflecting their long-term significance and potential for application or commercialization in a broader context.

Key Exploitable Result (KER): A KER is the asset that arises from exploitable results and possesses the highest degree of innovation and exploitable potential compared to others.

By making use of the intellectual property assets that were previously collected, a thorough IPR matrix has been constructed. The matrix functions as an all-encompassing and methodically structured depiction of the intellectual property terrain surrounding the project. It includes patents, trademarks, copyrights, and other pertinent assets. Four discrete tabs constitute the IPR Matrix, each of which serves a particular function.

Collecting Intellectual Property (IP) entails sending a detailed questionnaire to all project partners. Partners are asked about the technology they provided for the project, which is then categorized as Background (BG). Partners are also inquired about their intentions to either enhance the existing Background technology inside the project or to create new technologies exclusively for the project, categorizing these as Foreground (FG). Furthermore, within the Foreground category, partners are required to specify which elements they intend to exploit further. These exploitable assets are catalogued as Exploitable Results (ER).

The IPR Matrix is comprised of three tables plus the KER table.

The first table is dedicated to the intellectual property **Background IP** and offers a concise summary of each asset, including a detailed description, the protection it is entitled to, and the requirements for its use both inside and outside the project. The content registered to this date on this table, can be seen in Table 25 in the annex.

The second table is dedicated to **Foreground IP** containing the same information as the background IP table. The available content of this table can be seen in Table 26, in the annex.

The third table is dedicated to **Exploitable results** that have the potential to be exploited further. This segment provides a glance of the assets obtained from the undertaking that demonstrate encouraging potential for further application or commercialization. Additionally, this table contains information on how the other partners plan to use this result forming their individual exploitation plan. Its contents can be seen in **Error! No se encuentra el origen de la referencia.** Table 27, in the annex.

5.1.1. Innovation Roadmap

Achieving the first three milestones sets the foundation for the subsequent phase in intellectual property rights management. A roadmap has been delineated, as shown in the image above (Figure 38).

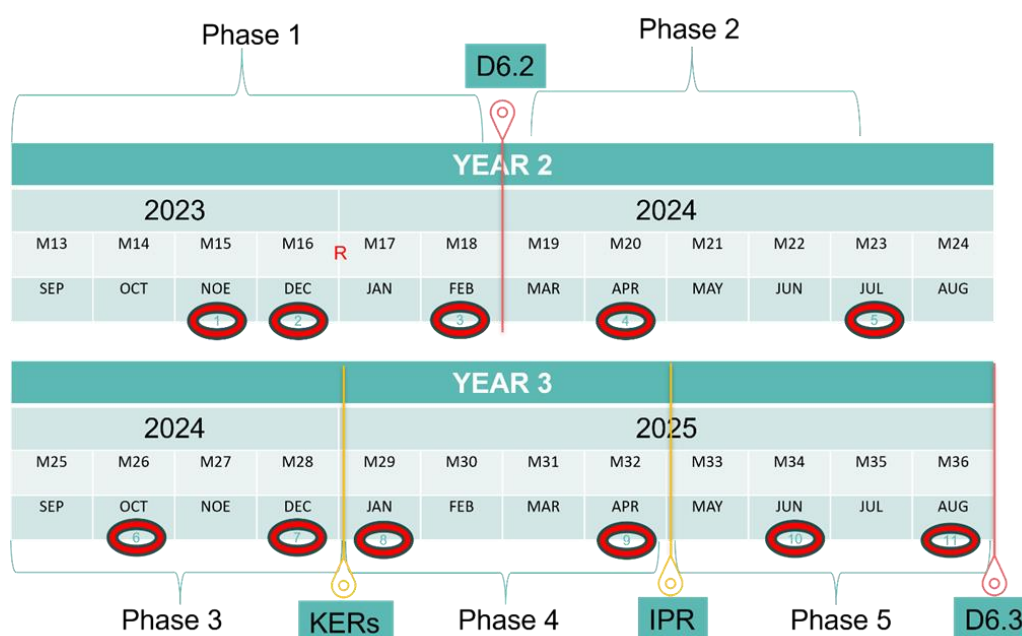


Figure 38 IPR & business management roadmap

The activities that have been carefully identified and strategically scheduled for the remaining time of the project comprise an extensive array of tasks that are vital for the innovation and exploitation strategy of the project.

During **Phase 2** of the project, a significant milestone is attained, affording each collaborator the independence to formulate well-informed choices concerning the commercialization of their distinct findings. To adequately prepare for this pivotal phase, it is necessary to devise individualized exploitation strategies that capitalize on the unique capabilities of each partner. Expanding upon deliverable D2.1, a comprehensive evaluation will be conducted to compile lists of stakeholders and competitors, thereby honing our strategic approach. This signifies a pivotal moment, during which collaborators are empowered and strategies for project success are refined. Milestone **MS4** mandates that collaborators delineate particular assets that are suitable for exploration, thereby facilitating the transition from conceptualization to market presence. This significant achievement establishes the foundation for an asset exploitation strategy that is dynamic and in line with our collective vision.

Drawing upon the knowledge gained in **MS4**, **MS5** endeavors to strengthen our foundation by constructing more exhaustive listings of stakeholders and competitors in comparison to those presented in document D2.1. By providing insights into the competitive landscape and facilitating the identification of key actors and collaborators, these refined profiles enhance our comprehension of the project ecosystem. As the undertaking

progresses, strategic decisions are informed by this. MS45 provides commercialization-oriented partners with the opportunity to utilize the Horizon accelerator services described in Section 3. These specialized services facilitate an efficient transition from research and development to the marketplace by streamlining the commercialization process and providing partners with customized assistance to strengthen their competitive advantage. According to **MS45**, if a partner expresses a notable inclination towards the commercialization of their assets, they have the option to leverage the Horizon booster services, as elucidated in the details provided in section 3. These specialized services serve as an invaluable resource for partners seeking to expedite and optimize the process of bringing their innovations to market. By harnessing the Horizon booster services, partners can benefit from a tailored support framework that not only streamlines the commercialization journey but also enhances their competitive edge, thereby facilitating a more efficient and effective transition from research and development to the marketplace.

Our principal objective for **Phase 3**, which is projected to be finished by the conclusion of 2024, is to definitively establish the Foreground (FG) and Key Exploitable Result (KER) lists, as they were initially delineated in the antecedent phases. An essential component of this stage entails the reevaluation of our Market Analysis, an undertaking commenced in Deliverable 2.1 (D2.1). It is crucial to conduct this revision in order to assess whether substantial alterations in the market environment may have an influence on the implementation and achievement of our project. Our objective is to identify and evaluate potential hazards that may be linked to our project approach in consideration of the changing market conditions. This will allow us to make well-informed decisions and make strategic adjustments accordingly. Our principal objective in MS6 is to reexamine and reevaluate the market analysis, identifying changes in the market environment and accurately ascertaining the present status of the aerOS project. This comprehensive guides strategic judgments in order to position aerOS in an optimal manner in light of changing market dynamics, customer inclinations, and competitive elements. The primary objective of MS7 is to perform a risk assessment for the commercialization phase of the aerOS project. This assessment will involve an examination of challenges and uncertainties associated with market dynamics, technical factors, legislative obstacles, and competitive threats. By conducting this thorough analysis, it becomes possible to develop a resilient risk management strategy that aids in taking preventative actions to mitigate or resolve prospective problems. As a result, the probability of the aerOS project's commercial launch being successful is ultimately increased.

We have arrived at a critical juncture regarding the market positioning of our undertaking during **Phase 4**. By employing the business information tools that were chosen in Phase 1, and potentially integrating additional ones as well, we shall initiate a strategic discourse with the domain of business analysis. Our principal objective is to conduct a thorough evaluation of the extent to which aerOS corresponds with the existing market environment, thereby acquiring knowledge regarding technological aspects, competitive positioning, and prospective customers. At this juncture, it is crucial to comprehend aerOS's position within the market ecosystem, assess the competitiveness of its technology, and discern prospects for expansion and distinctiveness. By adopting a proactive approach, we lay the groundwork for our go-to-market strategy, which guarantees well-informed choices that contribute to the establishment of aerOS as a competitive and prosperous product. By leveraging well-established business tools, MS8 conducts an exhaustive analysis to determine the merits and drawbacks of specific aerOS components and the undertaking in its entirety. This analysis discerns domains of proficiency and possible obstacles, investigating business models that facilitate the prosperous integration of aerOS solutions into the marketplace. The objective is to optimize the alignment of product and service offerings with the demands of the market. After conducting extensive market, business, and risk assessments, MS9 offers a comprehensive perspective on the market standing of aerOS. The combined results of these evaluations provide a comprehensive understanding of aerOS's attractiveness to prospective clients, its pertinence in fulfilling their requirements, and its uniqueness within the market. This data enables strategic decision-making, improves the positioning of projects, and capitalizes on competitive advantages to efficiently attract the target market, thereby enhancing the probability of achieving success in a highly competitive business landscape.

During the **final stage (Phase 5)**, an essential undertaking is ascertaining the proprietorship of intellectual property that is linked to the aerOS project. This includes patents, copyrights, trademarks, and other forms of proprietary assets. Precise ownership rights are of utmost importance in safeguarding the interests of partners and the innovations of the project by delineating the future uses, licensing, and transfers of these assets. Concurrently, it is critical to prepare for the development of deliverable D6.3. D6.3 is expected to be a substantial document for the project, necessitating the aggregation, structure, and delivery of pertinent data and discoveries throughout the project's duration. This guarantees that the document is coherent, well-organized,

and in line with the goals of the project. Both the ascertainment of intellectual property ownership and the formulation of D6.3 are essential components in the process of finalizing the project, safeguarding its resources, and recording the results of exploration and development endeavors and accomplishments. By concluding the business analysis in MS10, every project asset is effectively identified, underscoring the importance of establishing ownership of intellectual property rights (IPR) in order to safeguard valuable information uncovered throughout the analysis. The establishment of a clear definition of ownership guarantees controlled utilization, licensing, or transfer, thereby protecting intellectual property and enabling the open distribution of obligations, rights, and benefits among parties involved. After collecting crucial information and finalizing the IPR and innovation strategy in MS11, the attention turns to the smooth integration of this data and strategic insights into D6.3. At this pivotal moment, it is necessary to integrate project outcomes, information regarding intellectual property ownership, and novel approaches into a unified and well-organized manuscript. D6.3 functions as an all-encompassing documentation of the project, delineating accomplishments, and intellectual property, guaranteeing accurate recording and protection of intellectual property, and optimizing communication and subsequent decision-making concerning project results.

5.2. Individual Exploitation plans

The revised individual exploitation plans for each partner, which have been developed in accordance with deliverable D6.2, are detailed below.

5.2.1. Industrial, clustering and telco partners

Innovalia

Innovalia Association is a private and independent technological center that was created by Innovalia Group in order to articulate a critical mass capable of successfully achieving its long-term research ambitions and strategic objectives. Innovalia is an alliance for technology-based SMEs with headquarters in Spain. It has international presence with offices in Basque Country, Madrid, Catalonia, Canary Islands, Europe, Asia, the Middle East, and Central and South America. Since its foundation, Innovalia Association has developed a special sensitivity for and awareness of the characteristics of technology-based SMEs. Today, it has become a leader in the R&D area by and for SMEs in Spain. It also offers solutions for facilitating international innovation processes aimed at SMEs. As a technological agent of the Basque Country Technology Network (Innobasque), Innovalia brings together the skills, laboratories and resources of the companies that founded the association. Innovalia Association specializes in the development of ICT, Innovation Management and Meso, Micro & Nano-Technologies, parameterized according to the needs of each of the business units. In addition, Innovalia takes part in industry 4.0 and data spaces initiatives. aerOS will be exploited in following:

- Digital Factory Alliance (DFA). DFA was established in 2021 by BDVA Boost 4.0 and FoF (EFFRA) Qu4lity (big) data-driven digital transformation lighthouse initiatives. It is already at the crossroad of data and I4.0 and gathers a community of over 2000 stakeholders participating to the community open innovation activities “data open to all”. The DFA already provides 4 pillars to support both open and market driven innovation for accommodating the project assets and support market opportunity development. The DFA as a non-for-profit neutral stakeholder has already in place the necessary framework for immediate use by the community. It provides the manufacturing focused open innovation catalogues and partnership programmes to engage with the data space stakeholders (incl. DIHs and AI TEFs) and data space alliances for sharing knowledge (body of knowledge), ecosystem building assets (innovation campus), digital solution finding (flagship initiative) and engagement in business (business networks) at EU level, complementing national industry 4.0 initiatives activities and assets.

In this regard, aerOS will provide the framework for use reference models, certifications and provide effective data-sharing among the alliance.

- BAIDATA. The BAIDATA Association, led by Innovalia, is helping to drive the development of data sovereignty and the data economy. Founded in collaboration with the International Data Spaces Association (IDSA), BAIDATA implements research, development, and training activities to help build the public-private data ecosystem. BAIDATA stimulates and supports regional shared data space pilot

actions and promotes data space connectivity and interoperability with other regional and national data spaces and with the common European data market linked to this initiative.

Baidata aims at connecting and providing an interface between European and Regional Data Spaces and their public-private ecosystems, bring stakeholders together to improve and accelerate the use of data through pilot actions and training, assessment, internationalization, and promotional activities and designing new data-driven business models to improve business productivity, sustainability, and efficiency.

aerOS will provide a blueprint for an effective and secure data sharing, providing an infrastructure for promoting and expanding BAIDATA technical activities.

On the other hand, Innovalia will exploit aerOS for its internal advanced metrology products:

- Using a low latency big data solution to acquire and process information in real time from production lines,
- Contribute to the improvement and innovation of advanced metrology systems within contactless measurements and virtual pieces for the industry 4.0,
- Deliver business innovation and advanced digital tools through aerOS, enabling IoT solutions, big data management, cloud and AI,
- aerOS will help in the development of technologies related with embedded systems and device integration, contributing to the overall behaviour of cyber physical systems.

FIWARE FOUNDATION

The FIWARE Foundation is the legal independent body providing shared resources to help achieve the FIWARE mission by promoting, augmenting, protecting, evolving, and validating the FIWARE technologies as well as the activities of the FIWARE community, empowering its members including end-users, developers and rest of stakeholders in the entire ecosystem. The FIWARE Foundation is open: anybody can join contributing to transparent governance of FIWARE activities and rising through the ranks, based on merit. FIWARE Foundation is a non-profit organisation that drives the definition and encourages the adoption of open standards (implemented using Open-Source technologies) that ease the development of smart solutions across domains such as Smart Cities, Smart Energy, Smart AgriFood and Smart Industry, based on FIWARE technology. Founded in 2016, the foundation has Atos, AWS, Engineering, Madinah, NEC, Red Hat, Telefónica, and Trigyn Technologies among its Platinum members. Only by truly eliminating the existing technical and commercial obstacles hindering the effective usage of meaningful data, smart digital solution providers will be able to move forward and drive the market up, based on FIWARE technology. Using FIWARE technologies, organisations can capture the opportunities that are emerging with the new wave of digitalisation brought by combining the Internet of Things with Context Information Management and Big Data services on the Cloud. Using FIWARE technologies, developers can gather context information at large scale from many different sources. FIWARE also helps to easily process, analyse and visualise managed context information, easing the implementation of the smart behaviour and the enhanced user experience required by next-generation Smart Applications.

Over the years of its existence and development FIWARE built a strong community presence in these three different consistent and strong programs FIWARE Marketplace, FIWARE iHubs, FIWARE Accelerators.

-FIWARE Marketplace helps users, and their customers find innovative and the best open-source-based products and services and grow revenue by identifying customer needs and repeatable solutions leveraging FIWARE technologies and FIWARE partner ecosystem, at scale,

-FIWARE iHubs focus on building communities that will, in turn, enable local digital businesses to thrive not only at a regional but on a global level. They support companies, cities, and developers in their innovation and digitalisation journey by offering easy access to Open-Source technologies, business development support, and community building,

-FIWARE Accelerator Program supports Incubators, Technology Parks, Venture Capital Companies and Digital Innovation Hubs with training and coaching services. It offers technical assistance and business opportunities to highly innovative SMEs and Startups with scalable business models,

-FIWARE is active in standardisation bodies like ETSI and is the core maintainer of the agile standardisation initiative Smart Data Models (<https://smartdatamodels.org/>). In ETSI, the NGSI-LD API is continuously evolving to support the interoperability of smart solutions. FIWARE is a de facto standard in domains like Smart Cities, and gaining adoption in other ones, like Manufacturing, Energy or Mobility.

There are few main ways in which FIWARE will be able to exploit the results of the project:

-Implementing new core functions to Orion-LD Context Broker for distributed operations which will be available not only for FIWARE Foundation itself but for all FIWARE's users worldwide,

-The Marketplace is FIWARE's business tool, it currently hosts 200 solutions. AerOS pilots can be added to FIWARE Marketplace as they will be powered by the FIWARE technology. It will also be an added value for the project itself. The pilots will have global promotion, a visibility that will help position the solutions developed in the public administrations, but not limited, market more easily,

-Enhancing and extending FIWARE's Smart Data Models with new open and free models for Cloud, Edge, and telemetry domains. More than 1000 data models are currently in the smartdatamodels.org repository, contributed by more than 80 organisations and more than 120 contributors. New models will enlarge this common database of models widely used by the community,

-Improve or add new Generic Enablers in data Continuum, distributed security, and multi-plane analytics both in FIWARE's IoT enablers implementation and FIWARE Lab cloud federation.,

- Building Blocks that could be incorporated to the catalogue of components that the Data Spaces Support Centre is collecting for the deployment of data spaces in different domains in Europe,

-This is a great chance to gain Know-how and experience in Data Continuum, AI, Cybersecurity, and data governance which will benefit our FIWARE adopters.

FIWARE has implemented distributed operations in Orion-LD for aerOS, which is a result that can be exploited in any other project that needs distributed operations, which is a current trend in almost all projects developed in FIWARE. It is an important part of the NGSI-LD API that needs to be implemented for Orion-LD.

- More specifically, the developments consisted in implementing:
- Distributed GET /entities w/ entity maps,
- Loop protection using the HTTP header "Via",
- Periodic notifications for subscriptions,
- And more elements in Orion-LD.

As a result, a network of context brokers can be created, where several components support the gathering and access to data, each of them holding entities, such as a digital twin of a real object (e.g. a bicycle). If the brokers are federated (by means of a 'registration'), it means that each broker knows what entities the other brokers have.

The advantage is that for an entity query it is enough to contact one of the many brokers. For example, "give me all entities (bikes) that have an attribute called 'speed' with a value between 90 and 120".

The broker that receives that request, as it knows what entities all other brokers have, can "forward" the request, query all the other brokers, and then return the entire set of matching entities to the initial "queree".

A case of use could be a city federating with all other cities in the country and letting their applications offer country-wide services, or even worldwide.

The users of the service are developers, developing apps, but these apps have end users (any citizen), so a whole population can benefit from the federation capabilities.

FIWARE will exploit the results developed in aerOS by updating the current technology to be used in most forthcoming projects. Additionally, to the general exploitation activities listed above, the team will include it in the FIWARE catalogue. The FIWARE Catalogue offers a curated set of open-source components contributed by the Open Source Community, which can be integrated together with 3rd-party software around a Context Broker to bring support to the development of smart solutions in multiple sectors.

Finally, the functionality will be pitched within presentations to cities, municipalities, public sector interlocutors, as well as any other party interested in the benefits of FIWARE solutions.

TELEFÓNICA INVESTIGACIÓN Y DESARROLLO (TID)

Telefonica has set the initiative of Autonomous Networks as one of the priorities in its innovation roadmap. With this new initiative the management of networks will become more efficient and will require less intervention from humans. In this sense, Telefonica is heavily researching in new network paradigms like Digital Twins and closed-loop automation that will enable networks to work autonomously. But these paradigms require a data infrastructure that can integrate network monitoring data collected from different data sources while ensuring the governance over data by also integrating its metadata.

Following up on the results achieved in previous European projects like 5GROWTH, 5G-CLARITY, or PALANTIR, Telefonica will leverage the scope of the aerOS project to further evolve the Semantic Data Aggregator (SDA) as an implementation of a data infrastructure. The aerOS project, which targets the creation of a meta-operating system throughout the IoT-Edge-Cloud continuum, imposes challenges that will enable Telefonica to gain experience in managing highly distributed data. To cope with such challenges, Telefonica will extend the SDA to align with new data management approaches like data fabric or data mesh. The outcome of this research will be shared as contributions to standards ETSI CIM or IETF OPSAWG.

In addition, the wide variety of use cases addressed in aerOS, present a great opportunity for validating the novel data mesh paradigm, where one of its main principles is the ownership of data based on domains. In this regard, Telefonica, as Data Manager of the project as well as leader of the data governance task, will gain expertise in defining data domains and governance policies for the different use cases of the project. The lessons learned in the process will be applied to use cases which are specific to Telefonica business, and, in particular, to the initiatives related to the Network-as-a-Service (NaaS) paradigm.

In summary, the experience in data management gained with the aerOS project, will help Telefonica in developing a data infrastructure aligned with trends like data fabric and data mesh.

COSMOTE

An extensive presentation of COSMOTE's profile, the leading Mobile Network Operator of Greece launched in April 1998, was provided in D6.1 together with subtle evidence for the steps taken for commercial exploration of green, IoT and campus networks use cases. The company invests in the edge-cloud ICT enterprise solutions and seeks to assess new business models, exploring new revenue sources not only from building and operating networks but also profiting from the managed services to deliver and operate a wide set of network-aware enterprise applications. In this perspective, COSMOTE has a strong interest to explore the aerOS prototype, with special focus on the platform-agnostic, distributed intelligent edge that can accommodate federated, flexible, scalable IOT deployments building upon AI and the IOT-cloud technologies. As described in the initial plan, the developments of aerOS are evaluated in three perspectives:

- From the perspective of a technology supplier, to assume the role of edge-cloud provider and offer enterprise, beyond connectivity, services, supporting the vertical industries' digital transformation and capitalising the 5G network investments. COSMOTE intends to build upon its strong telecom and ICT competence to exploit the aerOS metaOS results offering federated, scalable, extensible, secure, distributed intelligent edge to support multiple use cases and enterprise domains.
- As a technology consumer, to exploit technology towards its own transformation, at the business level and for the network sustainability. The Cloud IoT continuum offered by aerOS can become a core platform to manage the telecom systems, services, and assets.
- To achieve its corporate sustainability targets. In this perspective, Pilot #5 for smart, energy efficient buildings are an attractive solution to be deployed in own telecom premises.

Drilling as part of the first-year activities into specific project developments that can support these perspectives, the focus is especially put on the following concrete project outcomes:

- The aerOS Context Broker developments based on the widely adopted standard NGSI-LD, to achieve a unified data fabric from heterogeneous IoT data, as well a unified network-compute fabric from the distributed, diverse cloud eco-system.
- The aerOS Orchestration that determines the optimal location to initiate the service deployment within the continuum (HLO) and once the appropriate infrastructure element of the continuum is selected, to further deploy the service through the (LLO), while managing the elements of the ecosystem with self-* capabilities.
- The aerOS AI components, identified both from the perspective of the aerOS embedded analytics, as well as for the AI models developments for energy efficiency and health-safe buildings in focus of Pilot5.
- The integrated Pilot5 demonstrator that is prototyped in an existing COSMOTE enterprise building and as such stands as the pilot for further deployments in other COSMOTE premises.

Switzerland Innovation Park Biel/Bienne (SIPBB)

The Switzerland Innovation Park Biel/Bienne (SIPBB) is a private Swiss non-profit organisation that conducts and supports industry-related and primarily applied research and development. It encompasses four applied research centres covering topics related to healthtech, additive manufacturing, battery technology and smart factory. Besides research activities, the SIPBB offers test – and demonstration platforms for several applications. The largest platform is the Lighthouse factory industry 4.0, built with the help of over 40 companies and coordinated by the Swiss Smart Factory (SSF) research center. This is a production line for Quadro – and hexacopter which focuses on automation and human-machine interaction in the context of industry 4.0. Within this line, many IoT data points are available, which can be used for further computation. With aerOS the different data entries can be collected and exchanged with further data from the own production line as well as with other parties as suppliers, customers and other test and demo labs. From these opportunities the following exploitation purposes arise:

- Exchanging and computing IoT-data of demonstrators, sensors, edge-devices etc. within the production line for further insights and enhanced understanding.
- Exchanging and computing IoT-data with suppliers of drone parts (e.g., PCB's) for quality improvement and CO2-calculation of the drone.
- Exchanging and computing IoT-data with other test – and demo labs for exchanging information and common improving of the production line.
- Dashboarding of collected, exchanged, and computed IoT-data along the production line.

Given that the drone production line is constantly evolving to present up-to-date and relevant solutions accessible to companies facing digital transformation, the project results will help develop new use cases within the Lighthouse factory's Industry 4.0.

The Swiss Smart Factory is also part of the Digital Innovation Hub (DIH) ecosystem and contributes to other national, European and international projects related to Industry 4.0 topics such as data networks (RE4DY), data spaces (Circular TwAIn) and value networks (M4ESTRO). In this regard, results from aerOS will contribute to the development of other research projects.

In addition, the knowledge created through aerOS will be transferred to the partners of the Swiss Innovation Park Biel/Bienne, notably through guided tours, events and training courses organized in the Swiss Smart Factory, as well as within and beyond the innovation networks to which SIPBB and SSF belong.

NASERTIC

One of the most relevant lines of action in NASERTIC consists of the implementation of public Telco services deployed on top of our own ICT infrastructure. NASERTIC boosts all Telco projects commissioned by the Government of Navarra and is the reference partner for the Public Corporations in our Community for everything related with the deployment, assistance, and maintenance of ad-hoc Telco services.

This line of activity has allowed our community to carry phone coverage, Digital TV and high-speed Internet connectivity (among other services) to 99.5% of our territory, which is possible thanks to our own telecommunication centers and the management of the Government of Navarra's redundant data processing centers, which host all the ICT services demanded by society. Simply put, NASERTIC offers the infrastructure on top of which other entities deploy their own ICT services which contribute and add value to the Navarra's society.

Keeping always in mind NASERTIC's vocation of public service, aerOS can be yet another technology to offer to Navarra's ICT scene. By hosting dedicated aerOS infrastructure, we would enable the Government of Navarra and public entities (including ourselves) to develop new services that fully exploit aerOS' core concept: the continuum. The seamless and transparent integration of clouds, edges and IoT sensors and actuators can be leveraged in the development of services aligned with the Government of Navarra's S4+ strategy: electric and connected mobility, healthy and sustainable food, green energy industry, personalised medicine, sustainable tourism, and audiovisual industry.

In conclusion, we expect aerOS to strengthen the digitalization capabilities of our territory and to boost smart specialization strategies and inclusive growth (S4+), by incorporating the meta-operative system in our infrastructure and encouraging all actors in Navarra to leverage aerOS to create value added services for our society.

S21SEC

After the acquisition of S21Sec and ExcelliumSA by Thales Cyber solutions, under the holding company Maxive Cybersecurity, the group has become a global leader in advanced technologies and cybersecurity.

S21Sec Cyber Solutions by Thales, which is the new name for the corporate brand, will leverage Thales' leading Cyber Solutions business to enrich its offer and reinforce the capabilities of its Global Security Operations Center (SOC) in Madrid through Thales networks, to ensure greater efficiency in incident detection and response processes and better support international customers. With more than €1bn in sales generated in 2023 through an extensive cyber portfolio, Thales is involved at every step of the cyber value chain, offering solutions ranging from risk assessment to protection of critical infrastructure, supported by comprehensive threat detection and response capabilities. The portfolio provided for IT/OT & Cloud cybersecurity services can be grouped as follows:

- Advisory services (Compliance & Regulatory, Cyber security Ratings),
- Cybersecurity Infrastructure (Network, data, application, cloud security),
- Managed detection and response (SOCaaS, Threat Intelligence detection and response, Threat Hunting),
- Test, adapt and prevent (Red teaming, Vulnerability Management, Application testing/code review).

S21SEC intends to use the results of the aerOS research to improve the process of continuous integration and continuous deployment of managed cybersecurity services using the DevPrivSecOps methodology, supporting the company's strategy for S21SEC's SOC services provided globally.

S21SEC will deliver a DevPrivSecOps methodology that will ensure security by design in the software deployment process of the different software components for the aerOS IoT edge-cloud continuum platform and will particularly focus on the cybersecurity enablers to be applied in such architectures.

S21SEC will apply DevPrivSecOps methodology in Research and Development department enhancing the S21SEC internal corporate process helping to create environments for recurrent testing in R&D projects. Additionally, the experience and knowledge in DevPrivSecOps principles and practices will help to build a corporate offering of consulting services oriented to the assistance and implementation of DevPrivSecOps processes and methodology to be incorporated in the company's service portfolio.

S21Sec's role in aerOS will focus on the corporate strategy for the deployment of cybersecurity services, aligning the business strategy with the objectives of the aerOS project. S21SEC is responsible for the management of threats, detection and handling of breaches, the building of incident response and recovery capabilities in organizations, prevention techniques, education of the employees with the best cybersecurity practices, and alignment of business goals with the cybersecurity principles.

S21SEC will enhance with the results of aerOS their offer for managed security services in IoT edge-cloud continuum deploying these services both in the edge and also in the cloud of aerOS platform. For S21SEC it is crucial that new managed service offerings are designed to enhance, optimize and transform value creation along the entire value chain, both on the provider and user side. For instance, the self-security component, once uploaded from TRL after the project, is expected to be used to provide cybersecurity incident detection services in S21SEC customers' cloud environments. This component can be used to monitor intrusions in S21SEC customers' cloud networks which are then reported to the SOC for analysis and response.

The implementation of security in decentralized edge-loud IoT environments will enable the identification and development of new technology needs, allowing the services provided by the enterprise to be upgraded to meet the needs of next-generation networks. With aerOS, S21SEC will achieve a new position to their offering for managed security services.

5.2.2. SMEs

8BELLS

EIGHT BELLS Ltd is an independent high technology company providing innovative solutions, based in Nicosia, Cyprus and Athens, Greece. We specialize in selected parts of Information and Communication Technologies (in the fields of Defense, Security, Space, Telecommunications, Cybersecurity, eHealth and Environmental Protection, with disruptive IT solutions. Our technical capabilities include Systems Networks Engineering, Cloud Computing, Privacy, Security Data Protection and Software development.

8BELLS operates a privately-owned cloud based on comprehensive deployments of OpenStack and Kubernetes to manage bare-metal resources into virtual machines and containers, respectively. Our Everything-as-a-service (EaaS) philosophy is to be able to provide a high quality as-a-service approach to software and hardware resources. The entire architecture embeds scalability, high performance and security across all resources and tenants. In this sense and based on a perfect mixture of service orchestration and a best-of-breed DevOps approach, the platform is able to handle a multitude of workloads across Neural Networks, Blockchain, Big Data and other areas of distributed and cloud computing.

8BELLS plans to include aerOS results related services to the existing corporate portfolio making impact in core-aerOS, as well as in supporting features (TSF), extending its experience in data governance (e.g. DFF - Data Format Fusion), Softwarized Networks 5G & NetApps, APIs development & containerisation and predicting Self Maintenance mechanisms.

Another major part of aerOS was our contribution in the Kubernetes domains, this made us recognized the need to enhance the scalability and security of our company infrastructure, and to achieve this, we're planning to integrate Kubernetes (K8s) orchestration with the advanced networking capabilities of CNIs like Cilium.

In order to maximise the impact 8Bells will focus on setting up good practices and guidelines for transfer of knowledge. 8Bells has a proven track record in smart networking, benchmarking and evaluation and business strategy. More specifically, 8Bells will exploit technologies such as NFV (e.g., VNFs/CNFs), programmable networks and VPN will be adapted to distributed IoT edge-cloud continuums, with intelligent reconfiguration capabilities (supported by policy based and/or AI methods), ensuring dynamic, low-latency intra- and inter-domain communications.

INQBIT INNOVATIONS (IQB)

InQbit Innovations (IQB) was founded by an international team, achieving a harmonious balance of entrepreneurship, research, and engineering. This diverse group united with the objective of creating innovations that address societal and market needs. In addition to its individual endeavours, IQB is actively participating in several Horizon Europe projects, including H2020-ICT-41-2020-EVOLVED-5G, HORIZON-DATA-01-04-FAME, HORIZON-DATA-01-03-OASEES, H2020-ICT-40-2020-PHYSICS, and HORIZON-DATA-01-01-TRUSTEE. Through these projects and its connection to the research communities, IQB leverages opportunities to disseminate project outcomes, expand its network, and strengthen collaborations with IT-related SMEs and industries.

More specifically IQB will:

- Leverage the outcomes of aerOS within academic and scientific communities (e.g by organising workshops),
- Utilize the knowledge and expertise acquired from aerOS to enhance research and development efforts across Europe,
- Aim to identify new research areas that can enhance IQB's collection of innovative services.

As previously mentioned in aerOS Deliverable D6.1, IQB, through its involvement in the aerOS project, will concentrate on the cybersecurity aspects of the edge-cloud continuum and the development of trust management over IoT deployments. This involvement will enable IQB to enhance its expertise in security related to IoT devices and expand its understanding of the edge-cloud continuum. The outcomes of aerOS will be particularly valuable as they will represent our research implemented and utilized by the pilots.

IQB's participation in the aerOS project is primarily through its involvement in implementing the cybersecurity and trust management components. More specifically, as the task leader in Task 3.4, IQB has successfully implemented the authentication and authorization infrastructure of the project. This infrastructure consists of IAM, focusing on authentication and authorization, and the Secure API Gateway, which aims to strengthen the access control capabilities of aerOS and ensure that access rights are preserved. Additionally, as the task leader in Task 4.5, IQB is developing the trust monitoring tool to ensure trustworthiness in aerOS. As such, IQB's initial exploitation plans are centered around the following pillars:

- Encourage IQB research activities related to IoT trust management and multi-attribute optimization models for efficient and accurate trust score calculations for devices and network entities across the edge-cloud continuum,
- Create new partnerships in the EU research domain with the purpose of initiating new opportunities with the project's stakeholders.

FOGUS

FOGUS INNOVATIONS & SERVICES P.C. is a thriving SME in Greece that aims at integrating state-of-the-art technological advancements and cutting-edge research achievements, towards an immersive communication and computing experience. Founded by a group of industrial and academic experts covering a wide range of disciplines in Information and Communication Technologies (ICT), FOGUS exhibits strong research record and vast experience in managing and implementing ICT Research & Innovation actions. It provides a comprehensive set of services, including software development, simulation and experimentation set up, data analysis and tooling, and modelling and performance evaluation. FOGUS emphasizes on the optimization of core procedures and processes of network functions by integrating machine learning, big data analytics and cloud-empowered optimization. Holding experience that ranges from the design of mobile communication protocols to the development of custom-made software, FOGUS undertakes: i) end-to-end set-up of network simulation and emulation environments for IoT and User-centric services, ii) development of network functions end protocols for access and transport network domains, and iii) analysis of big data with expertise on mapping network and service performance parameters to user-experience metrics.

FOGUS is currently operating an end-to-end deployment of LoRa/LoRaWAN IoT infrastructure with a cloud-enabled and modular application and network managers. This supports two key research and service lines of the company, namely network and service performance evaluation and campus/experimentation infrastructure development.

By participating to aerOS project, FOGUS is expected to gain expertise in concepts like IoT edge-cloud continuum. In parallel, FOGUS testbeds and simulation infrastructure will be extended in the context of aerOS, towards being compatible with 5G and IoT standards. The fact that FOGUS monitors the activities in 5G-PPP and EFFRA associations will assist on that as well.

The company has already gained experience by their participation in key exploitable components of the aerOS platform, that can be integrated into other products, including the self-healing module that crystallises the capability of autonomously recovering affected parts of the system both at the hardware and software level

caused by failures or abnormal states. It also can restart the system to pre-established routines scheduling, if necessary. FOGUS also supports the development and evaluation activities in aerOS pilot 5, by providing insights both to the communication infrastructure of the pilot and to all the data-related processes. For the communication part, FOGUS brings expertise in common protocols, such as MQTT, Webhooks, HTTP, and others. Regarding the data processes, FOGUS has experience with all the common data processes, i.e., data gathering, data storage, data cleaning, data processing, data analysis; using well-established practices in the IoT field, i.e., gathering via push and pull models, storage using timeseries formatting, processing and cleaning using well-known frameworks and libraries, and visualizing using de facto tools (e.g., Grafana). All this experience will enforce the company's position in the market or future research projects. Finally, FOGUS is involved into the qualitative and quantitative assessment of the pilots, participating into the execution of different methodologies that can be adapted per case. Based on well established procedures, the pilots will be assessed according to specific targets and values. This approach is expected to be applicable into other similar environments in the future, contributing with a critical phase of a system integration and testing.

In general, the involvement of the company in aerOS project is expected to strengthen company's position against the competition in the fields of experimentation and benchmarking. Also, since FOGUS invests on training and consulting services, the know-how acquired by the aerOS project will be exploited by the training and consulting sector in FOGUS to devise new courses and training material.

ICTFIICAL

The primary goal of ICT-FI is to enhance its scientific and technical proficiency in cutting-edge research topics, with a focus on providing tangible benefits to its clients, particularly in the realm of edge computing and its management. The organization has successfully realized this ambition by integrating project results into the knowledge base of its staff. Specifically, the outcomes of aerOS have been instrumental in fortifying ongoing research and development initiatives and augmenting the company's solution portfolio. In pursuit of the first objective, ICT-FI strategically incorporates aerOS results into its staff's expertise, leveraging this knowledge to propel current R&D endeavours. Moreover, these outcomes serve as a catalyst, fostering the creation of additional research projects in pertinent scientific and technological domains.

Addressing the second objective, ICT-FI is actively engaged in crafting an orchestration system designed to create and manage diverse clusters across multiple cloud domains throughout their lifecycle. This forward-looking initiative aligns with the organization's commitment to staying at the forefront of technological advancements.

Concerning the third objective, ICT-FI has achieved success in securing additional funding, strategically utilizing the orchestration system under development as a cornerstone for attracting support. This proactive approach not only ensures continued financial backing but also positions ICT-FI as a key player in shaping future research and innovation activities.

The participation of ICT-FI in aerOS has proven instrumental in maintaining competitiveness for forthcoming research endeavours. The organization has been proactive in disseminating the outcomes of aerOS through publications in various scientific forums. This collaborative effort, undertaken in close cooperation with research collaborators, has further strengthened the ties between the company and academic institutions. In summary, ICT-FI's strategic integration of aerOS results, ongoing development of an orchestration system, and successful acquisition of additional funding underscore its commitment to excellence, innovation, and sustained collaboration within the ever-evolving landscape of scientific and technological advancements.

INFOLYSIS

As already stated in aerOS D6.1 as per INFOLYSIS initial exploitation plan, INFOLYSIS will capitalize on aerOS results by increasing INFOLYSIS' presence and penetration in the respective areas of research, as well as facilitating processes to ensure the project's maximum visibility and impact within the business and scientific communities, as well as within the chatbot apps and virtual assistants commercial markets, in order to ensure quick adoption of project outputs and easier commercialization of its chatbot-based services.

INFOLYSIS participation to the aerOS project, through the INFOLYSIS provision of smart networking/connectivity contributions, API communication and security services, as well as the development

of a web app acting as an informative end-user virtual assistant within the framework of Pilot 5, combined with the participation and outcomes of relevant IoT and 5G related projects (ASSIST-IoT, EVOLVED-5G, SECANT), will further:

- Foster INFOLYSIS IoT based R&D activities coupled with smart networking, communication APIs and virtual assistant/chatbot technologies,
- Enrich the know-how and the research expertise of the company in IoT, edge cloud continuum and AI technologies under several different environments with focus on smart buildings,
- Demonstrate gains of the aerOS architecture in an edge deployment for energy efficient, sustainable, flexible, and health-safe smart buildings,
- Create new virtual assistant apps and chatbot based products and services targeting new markets and sectors in the field of smart buildings,
- Enrich its end user products with new functionalities and processes addressing new customer needs for sustainable, flexible and health-safe working environments.

In parallel, INFOLYSIS will take advantage of its role as WP6 Impact and T6.1 Communication leader and use its expertise to gain full exposure and influence within the business, scientific and IoT communities to ensure that the project's outputs are easily and quickly adopted during the second period (M19-M36) and even after the project's end.

Within these communities, INFOLYSIS through its communication channels, will communicate project outcomes and opportunities, explore future expansion and exploitation in current markets, products, and services, enrich its collaboration with IT-related SMEs and industries. Second period impact activities will focus on relevant markets and industries in order to fully leverage the novel business opportunities in the smart buildings field, related activities and business processes as addressed/generated by aerOS.

In specific, INFOLYSIS will:

- Exploit aerOS results within scientific communities and chatbot apps markets,
- Enhance its participation in the evolving SMEs ecosystem and chatbot apps markets,
- Contribute to the newly formulated IoT/AI chatbots market landscape and societal impact,
- Participate in new SME accelerator communities and incubator programs through which INF will further disseminate aerOS developments, results, and experimentation opportunities,
- Use expertise gained in the research activities of ongoing IoT/5G related projects in which INFOLYSIS participates for further enriching and promoting aerOS project's outcomes,
- Target new research opportunities for further enriching INFOLYSIS portfolio with new innovative services,
- Acting as a liaison among different research projects' common activities and promoting the engagement of SMEs in mutually beneficial activities,
- Communicating aerOS activities to associations and working groups in which INF is member (e.g. NetworkEurope, SME WG, 5G-PPP/6G-IA Comms WG, EuCloudEdgeIoT association and communication task force, 6G-IA/SNS etc.) diffusing in this way project results among several SMEs and startups that may act as external third-party experimenters/stakeholders,
- Reuse the gained knowledge and expertise from aerOS to move forward the public awareness for sustainable, flexible, and health-safe buildings.

PRODEVELOP

PRODEVELOP has 30 years of experience offering digital solutions to the port sector, including Port Authorities or Container Terminals. aerOS will give the opportunity to Prodevelop to optimize our current software offering solutions to port terminals. The potential users of our aerOS results are container terminals, and in particular EUROGATE CTL. We expect that the outcomes of the project to be validated through the Port

Continuum pilot will demonstrate the benefits of integrating aerOS cloud-edge-IoT orchestration functionalities into our digital solutions. aerOS results will be incorporated to the Big Data and IoT services and products in Prodevelop's portfolio, with special attention to POSIDONIA Terminal 4.0, our IoT and Big Data solution for Smart Ports. To be more specific, the three main exploitation outcomes identified during the first half of the project are:

- Alleviate the bandwidth consumption required for data transmissions from port CHEs to central cloud servers for data analytics. Beyond the distributed orchestration, both data fabric and frugal AI services or aerOS are considered key pillars for this outcome,
- The management portal, in conjunction with the Embedded Analytics Tool plus the self-* services are seen as an optimum way to guarantee a proper and almost real-time platform performance monitoring, which is considered as one of our cornerstones for improving the maintenance of our digital big data platform,
- The automation tools to be provided from the DevPrivSecOps methodology of the project will help on reducing the deployment of new components or the upgrading of currently deployed ones in our customer premises, while guaranteeing that the data and services are not susceptible of being attacked or compromised.

DST

DST is an Italian system integrator and digital company active in research, development, and innovation projects. DST provides a wide range of digital services to EU players, it is a Digital Consulting company, and its main business is to support its customers in the development and maintenance of IT solutions, adopting a Cross-Pollination Methodology. With over 200 employees and collaborators, DST participates in several national and international R&I projects. The Research and Innovation division is fully dedicated to the conception and development of innovative solutions such as, for example, new e-commerce services, semantic technologies, Artificial Intelligence (AI) technologies, and Big Data analysis.

In this respect, the development of the next generation of higher-level (meta) operating systems for the smart Internet of Things embedded in a compute continuum from IoT-to-edge-to-cloud contributes to the advancement of DST know-how in the field. aerOS has the potential to affirm itself as a European platform of key value for the development of the computing industry at the European level. In this way it could represent a relevant technological solution to fill a gap in the computing sector. Furthermore, the project may support DST's R&D activities by fostering its expertise and project DST into the technologies of the future.

The solution might also improve DST's capacities to process data from distributed sources by leveraging the edge computing's high bandwidth and low latency. In this way, the solution will serve as an enabler for the creation of further digital solutions. Furthermore, the flexible architecture of aerOS will further enhance the possibility of employ it in several context and guaranteeing trust, security and privacy.

All of this will also translate in an enhanced capability of DST of providing further services to its clients needing to manage a vast amount of heterogeneous and unstructured data.

Finally, the knowledge gained via the aerOS project, and the project outputs may act as a catalyst for the development of further projects. Participation in these initiatives might also benefit aerOS because it would make the project more widely known to other key players.

MADE

MADE is one of the 8 Italian Competence Centers, selected by the Italian Ministry of Economic Development, acknowledged as Digital Innovation Hub by European Union. MADE provides a set of knowledge, methods, technical and managerial skills on digital technologies to support companies in their digital transformation towards Industry 4.0. On the other hand, thanks to the large demo-center of over 2000 m², it provides an I4.0 – based pilot production facility for pioneering test, demonstration, and development project realization.

MADE mission is to lead companies digital and sustainable transformation, leading a complete industry migration towards digital transformation by i) informing and showing Industry 4.0 technologies, ii) explaining them by specific training activities, and then iii) transferring and implementing technological solutions through projects (Test Before Invest). MADE is therefore proposed as a technical interlocutor to which companies can turn not only to manage activities of innovation, technology transfer, applied research and assistance during the

implementation of 4.0 technologies, but also to receive a suitable support to reconsider their organizational and business models. Finally MADE is a public-private consortium composed of more than 51 partners clustered in: 4 Universities, 2 research facilities, 43 Manufacturing Companies including software technology providers and one public entity (Figure 39).



Figure 39 Area 2 digital simulation

Namely MADE testing facilities is composed by 25 technology use cases and 6 manufacturing technology scenarios simulating the integration of digital technologies in a complete manufacturing production process cycle. The second area is reserved for digital twins, lean production, and logistics 4.0 is a small compact plant, where the production of mechanical valves for the oil & gas industry is simulated, in a production chain. The area exploits, in a real production line, the advantages deriving from the use of digital tools such as Industrial IoT, Cloud, Data Analytics, Collaborative Robotics, Virtual Commissioning, Product and Process Digital Twin. The area includes robotics and mechatronics components, a transport line, AGVs for intralogistics, a machine tool and a station where individual components are assembled manually. The entire process is replicated in this area, where mechatronic processes and logistics can also be remodelled using the plant's virtual commissioning solutions. Materials are moved within the plant using logistics 4.0 and the product's progress can be traced in real time. A fleet of AGVs from different manufacturers is used to demonstrate various integrated single operator setups. An innovative indoor navigation system combined with a positioning system based on BLE beacons can be used to replan trajectories and identify the component used in the demonstration.

aerOS platform will improve the current status of the technological area introducing: (i) a more distributed (towards the edge-layers) computing power architecture that will enable real-time computing and permit to avoid transmission of huge amount of data to the cloud; (ii) introducing a Decentralized intelligence by Frugal AI/ML system that will contribute to increase network and orchestration efficiency; (iii) enable data interoperability and standardization for data coming from different third-party components and (iv) introducing ease of use and implementation of these applications by ad-hoc APIs that enable flexibility, scalability and versatility of the whole solution.

aerOS demonstration will allow MADE testing facilities to:

- Enable new technology scenarios and use case linked to IoT edge-cloud technology scenarios and data management,
- Demonstrate easy configuration of advanced networking and computing orchestration in the edge-cloud continuum,
- Demonstrate network and energy consumption efficiency concepts that industry 4.0 new technologies introduce,
- Update learning environment and infrastructure to nurture future teaching factory initiatives,
- Generate new knowledge to be transferred to MADE partners and ecosystem,

- Connect with European, national and international partner of Edge to Cloud innovation ecosystem. In addition, MADE will exploit aerOS knowledge within EDIH service portfolio and connect with the EDIH Manufacturing Network and AI Testing Facilities.

Expected exploitable routes leverages MADE mission pillars that are:

- Awareness Raising, showing aerOS solution in webinars, guided tours and demonstration event organized with end users,
- Education, defining new teaching factory courses,
- Test Before Invest, enhancing the renewed scenarios in future R&D project at regional, national, European level; generate new advisory services related to Edge to Cloud Continuum; develop new pilot services exploiting gained aerOS dataset.

5.2.3. DigitalTechnology Providers

TTControl (TTC)

With the trend towards intelligent and automated farming or, in general, with the trend of (semi) autonomous mobile machinery operation, safe and secure computing HW/SW platforms for connected and cooperative mobile machinery (e.g. for farming, construction and forestry) are a necessary precondition. There is a significant interest for such systems claimed from agricultural OEMs such as John Deere being a partner in the project, or others (potential) customers of TTControl. TTControl aims at developing a safe and secure high-performance platform, including e.g. a main control module for safe operation, gateway module, or a local HMI with corresponding external infrastructure. This will close essential gaps in the high potential area of smart farming, construction machinery domain, with huge market potential. Moreover, replicating the same platform in several vehicles will allow for autonomous operation of an electric vehicle driver-less fleet, which has in turn, potential to reduce the CO2 footprint. In addition to that, precision farming technologies offer a pathway to reduce resources, increasing yields and quality of produced goods on one side, and by means of the digitalized approaches integrated control of machines involved in production or construction process can be realized. All this will be supported by the proposed by TTControl solution for more autonomy in a field or at a construction side.

The aerOS project greatly supports the mentioned development activities and is an important step for TTControl to approach relevant markets during the project duration and beyond, leveraging project results for commercial exploitation in the future. As done with other developments of TTTech Group, in a longer term the results shall be applied to other industrial sectors as well. Utilizing the results and transferring them to other additional areas will allow TTControl to grow and establish extended product line(s). TTControl will add the expected project outcome, as from other R&D projects to the company product portfolio using the same business model when the technology has been productized.

To conclude, as a key off-highway product supplier, TTControl can meet safe and secure computing platform requirements for autonomous operation. With this, TTControl plans, in general, to increase its turnover and support as well as generate highly qualified, long-term positions in Vienna, Austria. In the long term, TTControl will potentially offer a new product line addressing (partially) automated driving and operation for mobile machinery to stay competitive in the next 5 to 10 years. Furthermore, including the TTControl's technology the Tier1 suppliers and OEMs will be able to offer performant and cost-efficient products on the leading edge of technology and improve their competitiveness.

ERICSSON

Extending the exploitation plan described in D6.1, Ericsson is leveraging the knowledge and experience working with partners from several backgrounds with different network management challenges. In 2023 Ericsson sold the Ericsson IoT Accelerator, a management platform for IoT networks. However, this does not represent a diminished role of IoT in modern networks. IoT continues to be an expanding use case as shown by the variety and applicability of each aerOS pilot. These unique challenges and the development of solutions drive growth and new thinking in our research and innovation departments. These also increase our exposure to Far-Edge and Edge-Cloud domains which may allow Ericsson to better meet the requirements of existing and future customers.

The development of pre-packaged analytical functions as part of the Embedded Analytics Tool has fostered a new round of powerful lightweight serverless analytics which plan to be leveraged through future publications. The abstraction of analytical function interfaces has created a new focus on generalised models for common Machine Learning operations such as Anomaly Detection and the reliability of models working with dynamic data sets/sources. Introducing more flexibility into these models and allowing them to be more robust has started discussions around our model development approaches and internal “Best Practises”.

aerOS will continue to provide Ericsson with an opportunity to foster the growth of its research and innovation departments focused on IoT edge-cloud continuum. The dissemination of knowledge and experience with respect to the aerOS project will continue internally through presentations with fellow researchers and managers, introducing new perspectives through the analysis and adaptation of our processes and approaches in development and finally communicating our experiences from working with external companies with product leaders who engage directly with customers.

SIEMENS

Siemens, being the largest industrial manufacturing conglomerate in Europe, is involved in the development and application of innovative technologies for many areas, mainly industry, infrastructure, transport, and healthcare. Siemens creates solutions that add real value to the diverse customers and verticals that those areas represent. Often, those solutions involve services provided by distributed digital infrastructure elements, such as edge computers, controllers, sensors, actuators, or cloud-based applications. For that reason, novel solutions for the cloud-edge continuum as the ones developed by the aerOS project constitute a well of exploitation potential for Siemens’ activities.

Siemens has positioned itself as a leading Industrial Internet of Things (IIoT) vendor with its Siemens Industrial Edge Platform. The Siemens Industrial Edge Platform provides a ready-to-use edge computing platform for the industry. It enables companies using this platform to optimize their workflows, save resources and improve quality by gathering, structuring, and using a wide range of data from machines, IT systems, the cloud, and other resources. By evaluating quality parameters in real time, companies can respond to deviations immediately. In the context of the aerOS project, Siemens focuses on integrating its Industrial Edge Platform as one of the execution environments of aerOS.

Additionally, aerOS highlights the combination of various branch-independent use cases. Due to the setting of an industrial platform, it is also possible for other providers to integrate their solutions effortlessly for industrial customers.

Another interesting offer in Siemens’ portfolio is Mindsphere, a cloud infrastructure perfectly adapted to the needs of industrial environments, for example in terms of cybersecurity. By the combination of the Mendix, Mindsphere, and the Industrial Edge Platform, Siemens offers the whole state-of-the-art IT-infrastructure from edge to cloud and easy and flexible no-code/low-code user interface design. Using this infrastructure in the context of the aerOS project, Siemens evaluates approaches to overcome the classical three-layered approaches of cloud, edge, and IoT, to transition to a seamless cloud-edge continuum. That will make it easier than ever to design, implement and orchestrate complex use-case fulfilling all requirements of industrial domains, such as cybersecurity and reliability by default. In short, Siemens aims to tackle the challenge of industrial machine learning operations to enable the standardization of machine learning offerings ultimately utilizing the strengths of cloud, edge and IIoT environments joint seamlessly.

As showcased by its product portfolio, Siemens recognizes Industry 4.0, the smart factory, and the IIoT as the future of industrial manufacturing. However, the right communication frameworks should be used to achieve such goals of flexible production plants and intralogistics. It is in that regard where the 5G broadband cellular networks and deterministic communication standards, such as TSN, open important new prospects for the company and its customers.

The performance of the infrastructure elements (devices or software applications) is key for an efficient deployment of 5G networks, especially in industrial and other mission-critical applications. For that reason, Siemens develops ultra-reliable communication elements such as the SCALANCE Industrial 5G routers. However, these solutions require higher layer communication technologies and services that leverage the potential of 5G deployments, gap that can be filled in many verticals by the aerOS meta operating system.

One of the goals of aerOS is TSN compliance. That aligns with Siemens' Time Sensitive Networking solutions, that aim to open new perspectives for highly agile and available communication for established industrial communication protocols, such as PROFINET or OPC UA.

Lastly, in the context of the aerOS project, Siemens also explores solutions for service and resource orchestration with the focus on resource and energy consumption optimization. This topic is especially relevant in the edge and far edge environment which is provided by the pilots of aerOS project. Originally, optimization problems were solved by Mixed Integer Linear Programming which is resource and time consuming. With the aerOS project, Siemens evaluates more efficient methods e.g., Deep Reinforcement Learning as orchestration approach.

5.2.4. End-Users-Stakeholders

ECTL

EUROGATE Container Terminal Limassol Ltd (ECTL) is part of the EUROGATE Group recognized as Europe's leading line-independent container terminal operator. The terminal is the island of Cyprus' main gateway to global trade, handling over 90% of containerized gateway cargo to the country. Since taking over the operations of the terminal the Company have invested heavily in modernizing the equipment and Operating Systems utilized in day-to-day operations.

The terminal's core operations are already digitized in a central Terminal Operating System (TOS), that aggregates data in real time from many different sources including vessel agent input, data from port authorities, customs and machinery operators or port workers, using field devices. The transfer of data is immediate to all relevant authorities upon confirmation resulting in reduced time for a container becoming available for pick-up.

Being a member of the EUROGATE Group currently operating twelve terminals in the wider European / Mediterranean region (so far), EUROGATE Limassol benefits from the growing focus in the Group for developing digital & automated solutions for automating terminal operations. (Twin Sim, T.I.C 4.0) Through these synergies the potential is amplified as technologies developed in one Terminal, could be transferred to the entire Group network.

ECTL participation in aerOS is considered an important step further testing & developing automated digital solutions in the terminal's operating procedures. The end focus is demonstrating to our valued customers the potential for enhanced quality of container handling services becoming possible through the growing digitization and the Company's willingness to modernize.

Even though port machinery are usually equipped with digital PLCs (programmable logic controllers), the data produced by the machinery is isolated on the machinery itself and only accessible on-site. Through the automated data collection and analysis through IoT devices and machine learning technologies, we expect that quality of service is elevated through higher operational efficiency. Specifically, if reduced machinery downtimes aimed through use case 1 (predictive maintenance) is expected to reduce the time a customer's ship spends in terminal thus minimizing their costs and making ECTL more competitive in the East Med region.

Container Terminals worldwide are already deploying propriety solutions utilizing optical character recognition and object detection to identify containers, cargo damages or container seals. aerOS will assist in providing a framework to deploy ML/AI models by utilizing a non-propriety an open infrastructure, allowing the faster deployment of ML/AI models or smart solutions. This is anticipated to automate container checks at the quay thus minimizing errors associated with manual checks and disputes with the customers.

The success in the deployment of the above aerOS enabled solutions within the EUROGATE Limassol operations, can result optimization of operation that ECTL can exploit going forward by promoting to its potential customers:

- The increase safety performance by automating high-hazard tasks (such as checking of the container seal) and removing the human factor from a high-risk area,
- The increase in the productivity of the port operations by eliminating the time required for manually checking containers for possible damages,
- The reduced downtime and increased maintenance efficiency through remote-diagnostics of port machinery that allow the deployment of ML predictive maintenance models. Higher machine utilization

due to lower downtime is anticipated to increase productivity with all associated benefits to ECTL's customers,

- Promote a unified approach and technology stack for the collection of IoT data, throughout the Eurogate group, based on the experience gained through aerOS. This could reduce development costs, enhance security of IT infrastructure and enable further similar projects for optimizing operating processes,
- Provide immediate and 100% reliable information to cargo-owners, shipping lines or other interested parties of the condition of their cargo (via connection of the TOS and the aerOS stack),
- Eradicate errors associated with manual checks and any associated customer complaints thus avoiding customer service dissatisfaction and deterioration in service quality,
- Emphasize to existing and potential new customers ECTL's willingness to move along with the changing times and provide the best container handling services it can offer to them through implementation of automated & digitalized solutions,
- The results from the aerOS participation will also be promoted to the local economy through ECTL's social network accounts to demonstrate the improvements achieved in the operation of a critical country infrastructure.

John Deere (JD)

The flexible architecture of aerOS serves as a focal point for the development and delivery of a comprehensive range of AI and communication solutions for end users (such as construction companies and farmers), as well as regional partners including dealers, farming contractors, and machinery rings. Additionally, aerOS's flexible architecture offers a starting point for directly interconnecting core process systems like primary food production or road construction with preceding and succeeding processes throughout the entire value chain. aerOS will also act as the foundation for integrated closed-loop control of mobile machinery across multiple sectors, encompassing farming, road construction, and forestry.

With John Deere's strong presence in the EU region, along with collaboration from other industrial and research partners, significant benefits for the EU economy and research landscape can be anticipated. Potential product and service innovations will stem from the project's results, leading to the creation of joint ventures that identify cross-manufacturer or cross-supplier cloud connections of sensor technology, machine systems, and third-party applications with high market and customer value potential. Consequently, the results mark the first step towards bringing products and services to market maturity through several subsequent phases. Implementing robust sensor technology and communication networks to support autonomous smart applications of mobile machines offers a promising approach. Fundamentally, all results and developed software and hardware components can be applied across various sectors, with John Deere farming, construction (Wirtgen Group), and forestry (John Deere Forestry) showing significant promise.

Regarding agriculture, the market potential is as follows:

In many EU countries, the number of farms will decrease by about half over the next 20 years, leading to a continuous growth in the number and acreage of large farms. Besides farms, contractors, service providers,

machinery rings, and others operate on agricultural land, facing challenges to produce effectively and in an environmentally friendly manner due to national and international competition and legal frameworks.

IT-based solutions will be essential for the demand-oriented supply of small sub-areas or individual plants, considering various environmental factors. Assuming the solutions developed using aerOS with their application for agriculture over several vegetation periods demonstrate significant improvements in efficiency, robustness, and practicality compared to existing processes, an increase in demand can be expected.

The anticipated improvements will provide project partners with a solid foundation for transferring potential developments into marketable products. For instance, John Deere has for some time been pursuing an approach of integrating various players, such as software companies, sensor manufacturers, or agricultural management system providers, into its Operations Center or software systems while maintaining its own data sovereignty. Many sensor manufacturers can already be incorporated into the system through partnering models and defined interfaces in a flexible and customer-specific manner. Successful and timely project results can be integrated into this framework and distributed to farmers via existing (not only John Deere internal) sales and dealer networks, ensuring rapid implementation.

Beyond the EU, countries such as Brazil or Canada, with large areas, low population density, and farm sizes often exceeding 10,000 hectares, are particularly relevant as potential application areas. Market potential in commercial horticulture and forestry is also high, as the sustainability and efficiency of cultivation rely on optimizing numerous influencing factors in conjunction with manual and technical resource management.

Economically, the widespread adoption of the project's results is expected to enhance farm competitiveness and significantly improve agriculture's ecological balance.

From John Deere's perspective, the following exploitation intentions underlie the project:

- Safety concepts for (partially) autonomous driving applications,
- (Edge-)cloud integration of own, as well as third-party, systems,
- Demonstrate software-as-a-service offerings and business models,
- Machine integration and networked machine interaction.

CloudFerro (CF)

CloudFerro, as a European cloud provider and an SME intends to capitalize on aerOS' positive effects in two aspects: i) obtained knowledge, expertise and experience during the project execution and ii) developed flexible metaOS architecture for building cloud-edge systems.

Firstly, most of the technologies and services operated by CloudFerro are open source based. With disparity in contributions to major open-source projects between European and global industry (major open software projects usually originate from US), it is difficult to find and build competence locally. Work planned in the aerOS project – thanks to its innovative and ambitious nature outline in the proposal – will greatly enhance CloudFerro's team knowledge regarding designing and development of distributed systems. This progress does not rely solely on the scope of the project. There are significant positive spillovers. For an SME, positive results of working with industry leaders (such as John Deere, Siemens or Ericsson) cannot be overlooked. Without the framework of the project, establishing such relations would be extremely unlikely. Similarly, direct access to and close collaboration with established research institutions will enable transfer of knowledge.

However, overcoming market failures and expanding expertise is not the primary goal for the company. Considering the latest trends in the cloud industry, AerOS architecture can enable CloudFerro to build sophisticated cloud-edge and multi-site (over multiple traditional clouds) systems. Without the project, pursuing flexible, infrastructure-agnostic solutions would be too expensive.

CloudFerro currently operates several traditional public clouds in separate locations and couple of big Earth Observation data repositories. However, its capability to consciously manage computing and data storage across multiple sites is limited to establishing static replication or routing policies. And changing those manually. aerOS modules can be used by the company to automatically distribute workload between multiple traditional clouds in resource- and self-conscious way, or between traditional clouds and edge locations. Something that CloudFerro is actively pursuing.

Crucially, aerOS objectives are in-line with the goals of the biggest CloudFerro's R&D project: GEP (Green Edge Processing). It's a multi-year development program aiming to move computing resources to energy sources. It will distribute computing resources geographically, to locate it directly at renewable energy, with a direct connection to the source (wind or PV farm). The company's goal is to create a sustainable, non-emissive and cheap pool of resources for its Earth Observation data processing. Integrating aerOS with it brings a new source of workload and users. Because AerOS can distribute workload directly to a location, without intervention from GEP central mechanism, it offers more flexibility and independence to separate locations. Thus, it makes the resource utilization more efficient and cost-effective. Direct results of the project planned by CloudFerro are:

- Connecting two renewable energy locations with aerOS,
- Connecting one traditional cloud with aerOS.

Additionally, CloudFerro intends to present its work within the scope of the project:

- At least in 3 European conferences,
- CloudFerro's social media.

ELECT

Electrum is an APC - Alternative Power Creator offering creative engineering solutions at every stage of the investment for the renewable energy sector. We carry out projects along the entire value chain and throughout the life cycle of the project and assets: Development – EPCM – Asset Management & ESCO – Reinvestment & Repowering.

The aerOS project's exploitable outcome for Electrum are two test field locations where the implementation of the IoT-Edge-Cloud meta-operating system is to be deployed and tested across Fog Computing domain, with Electrum's software runtimes installed on-premises at PV and/or Wind power generating installations. The system's architecture assures secure initial data processing on-premises running on Industrial AI Edge Computers as well as Cloud High Performance Computing operations in the distributed container-based datacenters.

The result type of the outcome is a demonstrator (Outcome Category - Research Achievement), where the power management system EMACS and the Virtual Power Plant microservice component designed by Electrum for the distributed IoT-Edge-Cloud deployment, can be tested, validated and certified. The demonstrator will allow autonomous management of the power balance between grid connection and local renewable energy generation capacity across two or more power generating locations integrated for system tests.

The aerOS objectives are in-line with the goals of a major internal R&D project at Electrum - the development of the Virtual Power Plant Solution. The VPP solution was designed to manage the distributed energy mix with the highest possible economical and energy efficiency. Based on microservices and supported by Machine Learning Operations, the VPP solution is a completed software + hardware package delivered as Infrastructure as a Service and / or Software as a Service, offering ultimate data security and new autonomous features highly increasing the efficiency of the renewable energy mix. The platform architecture features data integration across Micro Edge - Far Edge IoT devices, Edge AI Computing and distributed Cloud / HPC data centers, providing virtually unlimited scalability. The Customer Segment that will benefit from the project outcome is reaching all energy market participants, including:

- Independent Power Producers,
- Distribution Network Operators,
- Power Producers, Consumers and Prosumers,
- Operating & Maintenance firms,
- Banks, Insurers, Crypto-Fiat Exchange,
- Energy Storage Systems operators,
- Infrastructure equipment manufacturers.

Additionally, Electrum will capitalise on the knowledge, expertise and experience gained via other achievements of the project outcome, such as legal and regulatory analysis of the data centers located on Distributed Energy Resource locations.

The direct result of the Electrum's involvement in the project is development and test deployment of the microservice providing green energy availability schedule and price predictions to aerOS Orchestrator.

Electrum intends to present its work within the scope of the project:

- At least 1 white paper,
- At least 3 European conferences,
- 3 press releases published across social media.

5.2.5. Academic and Research Partners

UPV

UPV as Project Coordinator aims at enlarging its portfolio of successful projects and expects to make an impact in four technical areas related with the project goals. The research group will be supported by previous research and innovation actions led or with its participation. First, and the most prominent, UPV is expected to position aerOS results among the main contributions in the definition of the IoT-edge-cloud computing continuum architecture and principles. Second, it is expected to integrate and customise (to some extent) the capabilities of smart networking and self-* capabilities in the edge computing field (taking advantage of virtualisation and software-definition, besides the utilisation of modern orchestration technologies such as KubeEdge [33] and lightweight distributions of K8s). Third, UPV aims to gain huge experience in the federation of AI/ML services among heterogeneous nodes, in the cloud continuum, from the device till the cloud going through the edge and far edge nodes. Four, UPV expects to enlarge the test base of fruitful integration of distributed computing technologies in different verticals with special focus in transportation and logistics, energy, and Industry 4.0.

From an exploitation perspective, it must be considered that UPV is a public and dynamic academic institution. Therefore, it can be realised that the “business” issues that can be solved (needs that can be met) by the execution of aerOS are (i) enhancing the knowledge of specific technological fields developed in the project, (ii) gaining expertise and know-how with regards to actual deployments of technologies, (iii) augmenting the volume of the research team and consolidating that number, (iv) exploring new research lines and (v) envisioning potential continuation of the research through market-oriented actions (like technology transfer, consulting actions, start-ups or spin-offs creation). Considering this context, aerOS will allow UPV research team to:

- A. Improve research indicators of research team (Project Coordinator and researchers) due to scientific contributions to the community,
- B. Enhance and excel the current knowledge on the established fields of edge computing, CI/CD, orchestration, IoT, interoperability, self-* capabilities of heterogeneous computing nodes, machine learning, data science, distributed real-time systems and global communications and networking,
- C. Consolidate the knowledge gained during the last few years about Tactile Internet, Data sovereignty, computing fabric, Big Data, DLT and 5G technologies,
- D. Reinforce the orientation of the group towards practical application of the orchestration of the continuum and other technologies (aerOS is pilot-oriented and human-centric by design), through technology transfer actions,
- E. Keep a stable team of 4/5 researchers devoted to aerOS throughout the project duration,
- F. Establish a new research line of the group: self-* capabilities of federated computing nodes as part of the continuum,
- G. Tighten the gap with the market via exploring the creation of associated spin-offs out of the results of the participation in aerOS, including potential patenting and OSS initiatives contribution,
- H. Leverage the participation in aerOS for granting industrial contracts (tech-transfer or consulting activities), or, at least, put the group in a better position for endorsing this line of work.

Apart from the operative exploitation exposed above, other relevant results that will help UPV to improve its presence and impact in the field would be the following:

- At least 2 PhD theses will be conducted under the scope of aerOS,
- Attendance to multiple scientific conferences,
- Presentation of multiple scientific papers in journals and conferences focused various technological domains,
- Lecture at the university about the project and its most relevant findings,
- Organisation of conferences and seminars within the University (including posters).

Among the already identified exploitable results of UPV in aerOS are:

- aerOS Federator,
- Continuum-IOTA-message-management,
- Self-scaling,
- Self-monitoring-and-orchestration-suite,
- SmartWorkloadAllocation-AI-Algorithm.

Other results are still in observation and will be reported in the next deliverable of the WP.

NCSR D

Participation in aerOS, as Technical Coordinator of the project, is seen by NCSR DEMOKRITOS (NCSR D) as a direct step toward establishing a strong research and scientific position in the field of future network architectures and cloud systems. Based on the experience gained by aerOS trials, NCSR D will gain experience and expertise in novel cloud continuum infrastructures and related technologies, leading to the development of an automated federated framework for continuum orchestration on top of cloud infrastructures. Such tools that will be developed by NCSR D within aerOS are planned to be further exploited as services offered by NCSR D to external SMEs in the framework of the digital innovation hub Ahedd (<https://ahedd.demokritos.gr/>) that operates within NCSR D premises. Furthermore, NCSR D is home to the "Lefkipos" Technical Park, which houses many private companies and startups in the fields of IT and telecommunications, where the results of aerOS will be promoted, looking for possible synergies and joint ventures.

NCSR D participates as lead contributor in the development of the AI system of the Pilot 5 "Energy Efficient, Health Safe & Sustainable Smart Buildings". The development of new AI algorithms is going to enhance NCSR D's capacity and expertise in Artificial Intelligence. A wide range of algorithms are going to be developed that will later be used for further research purposes and potentially lead to new scientific publications in the sector of IoT.

Moreover, NCSR D foresees further exploitation opportunities of the expertise gained in 5G and cloud continuum by the signed partnership agreement with 5G Ventures Société Anonyme ("5G Ventures SA") that has been established pursuant to Article 93 of Law n. 4727/2020 (Government Gazette A' 184) and is a direct subsidiary of the Hellenic Corporation of Assets and Participations (HCAP SA). The purpose of the 5G Ventures SA is the establishment and management of Phaistos Investment Fund, based on the provisions of Article 7 of Law n. 2992/2002 (Government Gazette A' 54), according to prevailing market conditions, with guarantees for full transparency and accountability and complying with International Financial Reporting Standards (IFRS). The objective of the Phaistos Investment Fund is the public investment in businesses that are actively involved in 5G-related research and/or development of products and/or services in Greece, in sectors such as transport and logistics, manufacturing, public goods and utilities, health, tourism, information and media. As a result, NCSR D by exploiting the AEROS Platform through this collaboration will be able to support the development of services and products for the cloud continuum and 5G ecosystem.

Finally, NCSR D plans to exploit further the Cloud Continuum/5G expertise by innovation activities related to entrepreneurship and for this reason has proceeded to a collaboration agreement with the Municipality of Egaleo, and more specifically with the Entrepreneurship hub (<https://hub.egaleo.gr/>) for fostering further the development of innovative products and services related to 5G and Cloud Continuum by startups and young teams that are willing to get involved in the field.

SRIPAS

Participation of SRIPAS in the aerOS project will enlarge its portfolio of international projects and will allow to gain new and advance existing experience in the project's technical areas, e.g. semantic data processing and data homogenisation, autonomous systems, ML/AI and distributed AI (including ML/AI at the edge and federated learning). As a result, SRIPAS's standings and ranking in the academic area will be increased and a stronger scientific position around Next Generation IoT will be established.

SRIPAS research group dedicated to Next Generation IoT technologies, as a result of this project, will advance its research portfolio and toolset library. Specifically, its members will: (i) improve their knowledge of specific

research and technological fields related to the project, (ii) improve research indicators for team members, as a result of new publications, (iii) possibly extend the research team, (iv) explore new research areas and potential of participation in new project initiatives (funded by the EC, or nationally) and/or market-oriented actions, (v) build collaboration with the industry.

Since SRIPAS is a research institution, it will be intensively involved in dissemination activities including:

- Master's and PhD theses pursued within the scope of aerOS,
- Preparation of scientific publications and conference attendance,
- Communication at the Institute and within its network of contacts, about the project and its most relevant findings,
- Possible participation in tech-transfer and consulting activities based on gained knowledge.

Having aerOS in the project portfolio will enable SRIPAS to attract new PhD students, and young researchers, interested in up-to-date innovative research and working on topics with practical applicability in real life pilot use cases.

CUT

CUT is a relatively new but vibrant public university in Cyprus with several schools and state-of-the-art research laboratories. As a partner of aerOS, CUT mainly contributes to the project by participating in the use case "Smart Edge Services for the Port Continuum". The team from CUT brings to aerOS previous experience with successful projects related to the maritime sector (e.g., STM, STEAM, MARI-Sense, etc.) and innovative research capacity. The CUT team is primarily responsible for the Logistics/ Port Pilot deployment and validation in the EUROGATE Container Terminal (EGCTL), Port of Limassol together with Prodevelop, Spain. The researchers from CUT aim to facilitate the digitalization of the container terminal, as well as develop machine learning models for predictive maintenance of quay cranes/straddle carriers and computer vision applications (e.g., detect container damage, distinguish sealed from non-sealed containers).

In terms of exploitation, CUT plans to exploit the results of aerOS in the following ways:

- Deepening of knowledge of current state-of-the-art technologies together with the developed tools and methods, and the highly theoretical and dense results from desk and field research conducted by the partners of the aerOS project,
- Applying the developed methods in different use cases related to the maritime industry,
- Establishing new collaborations with different stakeholders and partners, e.g., from the maritime industry, especially Port of Limassol, EGCTL, and Prodevelop,
- Updating relevant courses taught on all levels with aerOS-related material.
- Pursuing of PhD and master's theses within the scope of aerOS,
- Developing of new ideas for future research based on the outcomes of the aerOS project,
- Disseminating the results in national/international workshops/conferences and journals,
- Organizing seminars/webinars for academia and end users to enhance the impact of aerOS.

In addition, CUT plans to further exploit the results of aerOS by:

- Leveraging the findings and outcomes of the aerOS project to make a significant impact within the scientific community, and at the same time, disseminating the knowledge gained to enhance the understanding of cutting-edge technologies and practices related to Port activities, i.e., damage/fault prediction, fostering collaboration and information exchange,
- Capitalizing on the expertise acquired through the research activities of existing marine related projects in which CUT is actively involved, e.g., MDigi-I, and applying the knowledge and insights gained to

further enhance and promote the outcomes of the aerOS project, creating synergies between different research initiatives,

- Exploring possible avenues where the aerOS project's outcomes can be applied, opening new opportunities for ground-breaking research and development, thus ensuring that CUT remains at the forefront of technological advancements in this area,
- Collaborating with industry partners, including the Port of Limassol, EGCTL, and Prodevelop, to design and implement specialized training programs, tailored to address the specific needs of the maritime industry, providing professionals with hands-on experience and knowledge transfer from the aerOS project.

POLIMI

The participation in aerOS means a valuable achievement for POLIMI in terms of constitution of a web of knowledge. Despite the topics of software architectures for far-edge systems are already in the technical background of the university, the involvement of the department of Management, Economics and Industrial engineering is aimed at constituting a body of knowledge for the deployment aspects and the effective results of an implementation of these technologies. The innovative aspect of this research makes also the topics addressed as particularly valuable in terms of sharing of knowledge and following from a close point of view the manufacturing application will give POLIMI the opportunity to publish scientific papers about manufacturing acceptance of these technologies as well as to increase the testbed pool to measure the most effective roadmaps for industrial digitalization.

Furthermore, the methodologies eventually developed to deploy aerOS solution in the manufacturing domain will be embodied by POLIMI and will be spread through its spinoff MIRAITEK in the context of Small and Medium Enterprises, which constitute the backbone of European manufacturing and usually are left behind in the digitalization journey.

Finally, the importance for aerOS in terms of academic perspective is not to be underestimated. It is highlighted the possibility to leverage on the expertise gained during the duration of the project to give students a new point of view on the modern challenges of manufacturing. The exploratory nature of the project in terms of acceptance of technology in manufacturing domain is already being included in PhD research and the effort scheduled on POLIMI's side has already led POLIMI to open the first of a series of research positions.

5.3. aerOS Innovations Overview

The aerOS project tackles the complexities of the IoT-Edge-Cloud continuum by providing a comprehensive, interwoven set of innovations that address key challenges like heterogeneous data, distributed control, security, and resource limitations. This set of results, which **has already been submitted to the European Innovations Radar**, shows how these diverse aerOS innovations collectively address the challenges of the continuum:

1. Unified Management and Orchestration

A primary challenge in the continuum is managing heterogeneous and widely distributed resources, which aerOS addresses through its Meta-OS foundation and multi-layered controlplane:

- **aerOS Runtime (Meta-OS runtime for resource and service fabric global functioning):** This component is integral to the aerOS meta-OS, acting similarly to an OS kernel by ensuring uniform management of resources across IoT-Edge-Cloud deployments. It inserts software capacities at the node level (Infrastructure Element or IE), providing resource abstraction, managing diverse OS and container runtimes, and enabling resource discoverability.
- **aerOS Orchestration Stack (Multi-layer orchestration stack):** This stack handles efficient workload placement by using a High-Level Orchestrator (HLO) and Low-Level Orchestrators (LLOs). The HLO is AI-powered and leverages inputs like trust services and federation to make distributed decisions on orchestrating computing resources across the continuum.

- **aerOS Federator (Management service for federation mechanisms):** This novel custom software addresses the challenge of connecting distinct infrastructure groups by establishing and maintaining federation mechanisms among domains. It manages cross-registrations and configurations using Data Fabric Context Brokers and allows the abstraction (federation) of domains and Infrastructure Elements (IEs) across the continuum, following the aerOS ontology.

2. Data Uniformity, Access, and Integrity

Dealing with vast amounts of disparate data across the edge and cloud requires mechanisms for consistent handling, privacy, and seamless access:

- **aerOS Data Fabric (Federated data fabric):** This innovation focuses on distributed data management throughout the continuum, treating data as a product. It includes tools for data security, privacy, data annotation, and translation, utilizing advanced access policies to ensure robust data governance.
- **aerOS Continuum Data Model (Data Model supporting data autonomy for homogeneity):** This model solves the challenge of heterogeneity by expressing the status of the continuum (resources, services, network, domains) in a novel way. It enables aerOS to homogenize data models at the edge, which facilitates ubiquitous access, exploitation of information, and seamless integration of heterogeneous data sources while preserving autonomy and privacy.
- **aerOS ContinuumIOTAmessages (Immutability and non-repudiable message exchange tool):** By utilizing the IOTA Tangle, this custom mechanism facilitates feeless, immutable, and non-repudiable data transactions among nodes. This is pivotal for exchanging specific critical messages, such as the trust score of Infrastructure Elements (IEs), ensuring network-wide visibility and reliability.

3. Trust, Security, and Privacy

A major hurdle in distributed continuum deployments is maintaining security, trust, and privacy, especially given the presence of numerous heterogeneous devices:

- **aerOS Trust Manager:** This service addresses the need for secure allocation decisions by validating and providing trustworthiness between Infrastructure Elements. It calculates a trust score for nodes (using static and dynamic assessments) and propagates this information, which is then utilized by the orchestrator when deciding where to allocate specific workloads.
- **DevPrivSecOps:** This innovative CI/CD methodology goes beyond standard DevSecOps by actively integrating Privacy and Security needs into the DevOps process. It offers the methodology, scripts, and software tools necessary for private, secure lifecycle management of aerOS components, allowing developers to create secure and privacy-aware software by design.

5. Intelligent Operations and Resource Optimization

To effectively leverage the compute power distributed across the continuum, specialized networking and AI capabilities are integrated:

aerOS Frugal AI (Methodology and software for frugal XAI): This innovation addresses resource limitations at the edge by enabling distributed AI tasks across the continuum. It uses MLOps and decentralized frugal AI mechanisms, including federated learning (FL), where tasks are subdivided and executed by infrastructure elements. It also includes explainability methods (XAI) for better transparency.

aerOS SmartNetworking (Script-based programmability for service mesh networking): This innovation focuses on optimizing and creating an intricately interconnected smart network architecture.

5.4. Detailed Innovation Analysis and Market Opportunity

This subsection explores the ten aforementioned key innovations developed under the aerOS project. Each one is examined in terms of its unique features, its potential in the market, and the practical steps that can help turn solid research results into real commercial outcomes. Together, these analyses aim to show how technical excellence can evolve into sustainable business opportunities.

1. aerOS Orchestration Stack

The **aerOS Orchestration Stack** introduces an advanced, AI-driven way to manage workloads across the IoT–Edge–Cloud landscape. Its design uses a clear two-level structure, separating the decision layer from the operational one. This setup allows for more efficient and flexible distribution of computing tasks in highly dynamic environments. Considered both a *new product* and a *significantly improved service*, it offers benefits that are easy to recognize: reduced latency, lower operating costs, and improved reliability. In essence, it tackles one of the hardest problems in distributed computing—how to coordinate different resources effectively without adding complexity.

Market Opportunity Analysis

The market for intelligent continuum management is still emerging, but demand is growing quickly. Many current tools can handle either cloud or edge orchestration, yet few can seamlessly bridge both. The aerOS Orchestration Stack fills that gap with its AI-based, two-tier system that looks at the entire continuum rather than just isolated components. This broader focus gives it a clear competitive advantage in a space where existing solutions are still limited.

Consortium Roles and Priorities

This innovation has been developed through the combined expertise of **ICT-FI**, **NCSRD**, and **UPV**. Together, these partners are driving both the technical and strategic work needed to move the solution closer to market readiness.

Support Needed for Market Success

To reach full market potential, the consortium has identified several key needs:

- Connections with investors to secure growth funding.
- Guidance in business planning and commercial strategy.
- Legal and intellectual property support to protect innovation assets.
- Mentoring to strengthen leadership and operational focus.
- Collaboration with other SMEs to build a broader partner network.
- Strategic alliances with large industry players to open early customer channels

2. aerOS Data Fabric

The **aerOS Data Fabric** delivers a complete and practical approach to managing data across distributed environments. It follows a “data as a product” concept, ensuring that every piece of information is governed, traceable, and secure. Alongside its integrated tools for privacy, security, and data governance, it provides organizations with a structured way to turn fragmented data into a coherent, valuable resource. Classified as a *new product*, a *significantly improved service*, and an *enhanced organizational method*, this innovation stands out for its clarity of purpose and market relevance. By enabling data to be treated as a managed, discoverable asset, it paves the way for new, data-driven services and sustainable business models across the IoT–Edge–Cloud continuum.

Market Opportunity Analysis

The market for advanced data management is already well established but continues to expand as the need for trusted and integrated data systems grows. Within this space, the aerOS Data Fabric brings a fresh perspective. Most existing platforms remain generic, whereas aerOS has been purpose-built for the complex and dynamic nature of the continuum. Its governance-first and interoperability-focused design create a strong competitive edge, allowing it to stand apart from conventional data management solutions and appeal to organizations seeking reliability, control, and scalability.

Consortium Roles and Strategic Priorities

This innovation is being advanced by **TID** and the **FIWARE Foundation**, who combine technical expertise, open-source experience, and a strong understanding of industrial needs to ensure that the aerOS Data Fabric remains both adaptable and sustainable.

Support Needed for Market Success

To ensure its smooth transition from research to market, the following areas of support are considered essential:

- **Investor readiness training** to prepare for funding opportunities.
- **Business plan development** to sharpen the go-to-market approach.
- **Market expansion support** to scale the solution internationally.
- **Collaboration with SMEs** for complementary integrations.
- **Executive training** to strengthen strategic leadership capacity.

3. DevPrivSecOps methodology

The **DevPrivSecOps** methodology and accompanying toolset mark a major evolution beyond traditional DevSecOps practices. By embedding *privacy-by-design* principles directly into every stage of the software lifecycle, this approach ensures that privacy and security are not treated as optional add-ons but as core design elements. Classified as a *significantly improved process* and an *enhanced organisational method*, it stands out as clearly innovative. Its purpose is to help organisations reduce regulatory risk—such as compliance with GDPR—and strengthen customer confidence by turning privacy into an automated, measurable, and continuous part of software development.

Market Opportunity Analysis

The market for DevOps and security solutions is mature yet expanding steadily, driven by increasing demands for transparency and compliance. Although this space is already home to several established players with strong technical offerings, **aerOS DevPrivSecOps** occupies a valuable niche. Its direct integration of privacy-by-design principles into development workflows addresses a growing pain point that larger vendors have yet to solve effectively. This makes it especially relevant for organisations seeking to align innovation speed with regulatory assurance and customer trust.

Consortium Roles and Strategic Priorities

This innovation is being led by **S2ISec**, whose expertise in cybersecurity and privacy engineering has been pivotal in shaping both the methodology and the supporting toolset.

Support Needed for Market Uptake

To fully prepare this innovation for commercial use, the following support areas have been identified:

- **Business plan development** to evaluate potential product or service offerings.
- **Legal and IPR guidance** to secure ownership and protect key assets.
- **Partnerships with large enterprises** to validate the methodology at scale and explore licensing opportunities.

4. aerOS Continuum Data Model

The **aerOS Continuum Data Model** introduces a new way of describing the full IoT–Edge–Cloud continuum—from resources and networks to services and domains—within a single, unified framework. By supporting federation, seamless access, and the harmonization of diverse data sources, it addresses one of the toughest barriers in digital infrastructure: interoperability. Classified as a *new product* and regarded as *very innovative*, this model effectively serves as a “Rosetta Stone” for the continuum. It creates a shared language that allows different systems to communicate, paving the way for intelligent coordination and large-scale automation.

Market Opportunity Analysis

This innovation is positioned in an *emerging market* where the demand for interoperability standards is accelerating, yet comprehensive solutions remain scarce. Although a few established players are active in related domains, none offer a universal schema designed specifically for the continuum. The aerOS Continuum Data Model's ability to unify heterogeneous systems provides a powerful first-mover advantage and positions it as a strong candidate to become a reference framework—or even a de facto industry standard—in this evolving space.

Consortium Roles and Strategic Priorities

Development of this model is being driven by **UPV**, **TID**, and **NCSR**, combining academic depth, industrial insight, and applied research expertise to ensure technical robustness and broad applicability.

Support Needed for Market Success

To accelerate adoption and commercialization, the following areas of support are identified:

- **Business plan development** to outline a clear commercialization path.
- **Legal and IPR advice** to navigate standardization and protect core assets.
- **Partnerships with large corporations** to validate and promote real-world uptake.
- **Mentoring and coaching** to strengthen both technical leadership and strategic management

5. aerOS runtime

The **aerOS Runtime** forms the core of the aerOS architecture—a kernel-like component that delivers resource abstraction, decentralized orchestration, and consistent resource management at the node level. As a *new product*, it stands out as *obviously innovative*. This layer provides the technological foundation for a truly hardware-agnostic and distributed operating system, addressing one of the industry's oldest challenges: fragmentation. By unifying resource management across devices—from small sensors at the edge to large-scale cloud servers—it enables seamless application deployment anywhere across the continuum.

Market Opportunity Analysis

This innovation represents a *market-creating opportunity*, introducing a new category of unified node-level management. Its defining strength lies in its ability to offer kernel-level control across diverse hardware types, something that current tools and platforms fail to achieve in an integrated way. Although the market features several established players in adjacent domains, none match the aerOS Runtime's depth of integration or its capacity to operate uniformly across the entire continuum. This positions it as a truly disruptive solution, capable of reshaping how distributed computing environments are designed and managed.

Consortium Roles and Strategic Priorities

This innovation is being led by **UPV** and the **FIWARE Foundation**, whose combined expertise ensures that the runtime's design remains both technically robust and open for wider adoption within industry ecosystems.

Support Needed for Market Success

To accelerate market entry and long-term growth, the following areas of support have been identified:

- **Investor introductions** to attract private-sector capital.
- **Business plan development** to define and refine the market-creation strategy.
- **Legal and IPR support** to safeguard foundational intellectual property.
- **Partnerships with SMEs** to develop complementary tools and applications that enhance the runtime's ecosystem.

6. aerOS Federator

The **aerOS Federator** is a purpose-built software component designed to automate the creation, updating, and ongoing maintenance of federation mechanisms across multiple domains. Recognized as a *significantly improved process*, it is regarded as *highly innovative*. By addressing one of the most persistent barriers in distributed systems—interoperability—it allows separate infrastructures to connect and function as part of a cohesive whole. In doing so, the Federator turns what has traditionally been a complex, manual, and error-prone task into a streamlined, automated process, enabling the delivery of seamless, continuum-wide services.

Market Opportunity Analysis

This innovation operates in an *emerging market* where the demand for cross-domain integration is expanding rapidly. While several established vendors provide partial solutions, none offer a product that automates federation specifically for the IoT–Edge–Cloud continuum. The aerOS Federator’s strength lies in replacing fragile, custom-coded links with a robust, reusable, and productized framework. By doing so, it helps organisations accelerate deployment, reduce operational costs, and bring new services to market more quickly.

Consortium Roles and Strategic Priorities

The main partners driving this innovation are **UPV**, **FIWARE**, and **DST**. Their combined expertise in software architecture, open-source technology, and distributed systems ensures that the Federator is technically solid and well aligned with market needs.

Support Needed for Market Success

To advance commercialisation and scale adoption, the consortium has identified the following needs:

- **Investor introductions** to secure funding for growth and market rollout.
- **Business-plan development** to define the go-to-market strategy.
- **Legal and IPR guidance** to protect the software’s intellectual assets.
- **Collaboration with SMEs** to build complementary integrations.
- **Partnerships with large corporations** to act as early adopters and reference customers.

7. aerOS Trust Manager

The aerOS Trust Manager is a key element of the aerOS framework, designed to ensure that every node operating within the IoT–Edge–Cloud continuum can be trusted. It continuously measures both static and dynamic factors to produce a verified trust score for each node. Classified as a *new product* and viewed as *very innovative*, it introduces a practical way to quantify trust—something that has long been a challenge in distributed environments. This score becomes a decision-making tool, allowing secure and autonomous allocation of workloads, which is particularly important in complex or mission-critical deployments.

Market Opportunity Analysis

The Trust Manager is positioned within an *emerging market* that is increasingly focused on reliability and security in distributed computing. While several established companies operate in the wider cybersecurity domain, none provide a dynamic, continuum-aware trust-scoring solution like this one. Its specialization gives it a distinctive competitive edge, offering a level of contextual assurance and adaptability that traditional, static security systems cannot achieve.

Consortium Roles and Strategic Priorities

This innovation is being led by IQB, bringing strong expertise in digital trust, risk assessment, and secure automation. Their leadership ensures that the Trust Manager evolves as both a technically solid and commercially viable component of the aerOS ecosystem.

Support Needed for Market Success

To guide the Trust Manager from research to market adoption, the consortium highlights the need for:

- Business plan development to shape a clear 3–5-year commercialization path.

- Market expansion support as the product reaches maturity.
- Collaboration with SMEs to integrate the solution into broader security offerings.
- Partnerships with large enterprises to run pilot projects and validate performance at scale.

8. aerOS Smart Networking

The **aerOS SmartNetworking** component introduces a new generation of intelligent, software-defined connectivity within the aerOS ecosystem. Built on advanced technologies such as **eBPF** and **OpenFlow**, it creates an agile service-mesh architecture that handles routing, security, and load balancing in real time. Recognised as a *new service* and *clearly innovative*, it replaces static networking approaches with a dynamic, programmable layer that adapts automatically to application requirements and changing continuum conditions. The result is a significant improvement in network efficiency, reliability, and protection across distributed infrastructures.

Market Opportunity Analysis

SmartNetworking operates within an *emerging market* that is rapidly evolving as organisations seek smarter, more flexible ways to manage connectivity across hybrid and distributed systems. Although there are established competitors in software-defined networking, few offer a solution combining eBPF-level efficiency with programmable control at this scale. This distinct approach gives aerOS SmartNetworking a strong early-mover advantage, especially among users facing the limitations of conventional, rigid networking frameworks in dynamic IoT–Edge–Cloud environments.

Consortium Roles and Strategic Priorities

The innovation is being developed and validated by **NCSR**, drawing on its long experience in high-performance networking, distributed computing, and secure systems integration.

Support Needed for Market Success

To ensure successful commercial rollout and sustained growth, the following types of support have been identified:

- **Business-plan development** to shape a clear go-to-market strategy.
- **Market-expansion support** to scale adoption across new sectors and geographies.
- **Legal and IPR guidance** to protect the novel network architecture.
- **Partnerships with large corporations** for pilot projects and strategic deployments.
- **Executive training** to strengthen commercial and leadership capabilities.

9. aerOS Continuum IOTA messages

The **aerOS ContinuumIOTAmessages** service brings in a custom way for nodes to exchange important messages safely and without fees, using the **IOTA Tangle**. It's considered *very innovative* and works by making every message permanent and tamper-proof, which keeps communication between nodes reliable and verifiable. This is especially useful for sharing trust scores and other key system data. In short, it tackles one of the biggest issues in decentralized systems — how to be sure that the messages used to build trust can actually be trusted.

Market Opportunity Analysis

This work opens up a fresh market space for secure, DLT-based communication in distributed systems. Using the IOTA Tangle gives it a big edge: messages can move fast and stay secure without any transaction costs, something that traditional blockchains still struggle with. There are some competing technologies around, but none that blend this level of performance, cost-efficiency, and reliability. Because of that, **aerOS ContinuumIOTAmessages** stands out as an early, credible option for organizations exploring trustworthy messaging across large-scale, decentralized networks.

Consortium Roles and Strategic Priorities

The development is being led by UPV, bringing in strong research experience in distributed computing and secure data exchange to make sure the service is both robust and practical to deploy.

- **Support Needed for Market Success**

To help move this innovation toward real-world use, the team has highlighted a few areas of support:

- **Investor connections** to fund a startup or spin-off effort.
- **Business-plan support** suited to a new and emerging market.
- **Legal and IPR guidance**, especially on DLT and data-exchange rules.
- **Mentoring or coaching** from experienced founders in similar areas.
- **Access to an incubation or accelerator program** to support early development and scaling.

1. aerOS Frugal AI

The **aerOS Frugal AI** framework introduces a practical way to run distributed AI tasks, such as federated learning, across the full IoT–Edge–Cloud continuum. It's a *new service* and is seen as *obviously innovative* because it directly tackles one of the toughest challenges in AI today—how to bring advanced intelligence to small, low-power devices. By allowing these devices to collaborate and learn locally, it makes it possible to generate valuable insights right where data is created and used. In simple terms, it brings powerful AI capabilities out of the cloud and closer to where decisions happen.

Market Opportunity Analysis

This innovation steps into a *mature but fast-growing market* for AI and MLOps tools. While several major players already dominate the space, most focus on cloud-heavy solutions that don't perform well on limited hardware. **aerOS Frugal AI** fills that gap by making AI lighter, more efficient, and easier to deploy at the edge. That focus gives it a clear niche and a real differentiator against traditional cloud-based systems. As more industries move toward local processing and privacy-preserving AI, the need for frugal, distributed intelligence is only going to grow.

Consortium Roles and Strategic Priorities

The work is being driven by **SRIPAS**, **LMI**, and **PRO**, combining their strengths in applied AI research, software engineering, and system integration to make sure the framework is technically solid and ready for real deployment.

Support Needed for Market Success

To push this innovation forward, the consortium has identified a few areas of support:

- **Investor introductions** to back marketing and sales activities.
- **Business-plan guidance** to fine-tune its market approach.
- **Market expansion support** to reach more regions and sectors.
- **Partnerships with SMEs** to grow a wider innovation network.
- **Collaborations with large corporations** for high-profile pilot projects.
- **Executive training** to strengthen the commercial leadership team.

5.5. Key Exploitable Results

The ten innovations discussed in the previous section make up the core technical pillars of the aerOS project. Each one was reviewed for its specific strengths, market potential, and level of maturity toward becoming a concrete, usable result. Building on this groundwork, the next section turns the focus to the **Key Exploitable Results (KERs)**, the most promising outcomes drawn from the wider set of aerOS innovations. Within the context of a project, the Key Exploitable Results (KER) play a vital role as they are acknowledged as the

project's most essential assets. Their distinguishing factor lies in their innovative nature and significant potential for commercialization, setting them apart from other project assets currently accessible. These unique characteristics make them outstanding contributors to the overall success of the project. The innovativeness of KER is characterized by the integration of state-of-the-art concepts, technologies, or techniques, which not only make them distinct but also have the potential to generate significant advancements.

The considerable potential for monetization adds an additional level of importance to these assets beyond their present worth. This possibility not only improves the project's financial viability but also highlights the strategic significance of these components in attaining commercial success. In addition, KER play a crucial role as major contributors of the business analysis tools that will be used in the next stages of the project. Their advice and data play a crucial role in guiding and shaping the commercialization plan, making them indispensable components. This emphasizes the vital role that these assets play in offering useful insights and information, enabling well-informed decision-making during the commercialization process. To construct the most successful business plans, we leveraged the experience, resources, and strategic guidance available through the European Union's support frameworks. This approach reflected our commitment to utilizing the most effective tools for research, development, and innovation throughout the aerOS project.

By aligning our business plan with key European initiatives, we gained access to valuable knowledge, and collaborative networks that strengthened the overall impact of the project. This integration demonstrated our dedication to excellence and innovation, reinforced the credibility of aerOS, and positioned it to seize new opportunities within the European market. Through this strategy, we ensured that our business plan remained comprehensive, well-informed, and capable of sustaining long-term success.

The following table lists the KERs identified by the consortium, which constitute the most creative components of the aerOS project. The KERs provide a brief overview of the project's technical progress, highlighting the innovative improvements crucial for its success. Every outcome is a crucial element of the project's creativity, demonstrating the consortium's dedication to exploring the limits of technological capabilities. As the research advances, the collaboration expects to offer comprehensive descriptions and optimize the results of these ongoing KER. This approach emphasizes the consortium's dedication to both present innovation and future advancements that may arise as the project progresses. By maintaining an iterative and proactive approach, the aerOS project may effectively adapt and respond to new opportunities, thereby enhancing its influence and contribution to the technological field (Table 19).

Table 19 List of identified KERs

A/A	KER	Description	Partners
KER1	aerOS MetaOS	The aerOS metaOS consists of the aerOS runtime, enabling the registration, management, and monitoring of minimal processing units (IE) as service execution units. Additionally, foundational services are provided to facilitate coordination and organization among diverse and dispersed computer resources. This includes integration, administration, and the management of data congestion for Edge IoT devices.	Consortium
KER2	aerOS Orchestration Stack	The aerOS orchestration stack is comprised by 2 level orchestrator components with decision engine (High-level-orchestrator) separate from enforcement layer (LLOs). LLO that can orchestrate computing resources over any runtime on top of K8s environment. Implemented as K8s operators capable to orchestrate resources based on CRD requests that may originate from different HLOs	Consortium
KER3	aerOS Data Fabric	Consist of data as a product methodology, tools data annotator, data translator. The context broker for holding current state of continuum and NGSI-LD extensions for federated continuum state (update and sharing)	Consortium

KER4	aerOS DevPrivSec	aerOS custom Methodology for CI/CD and aerOS scripts for pipelines implementation, plus software tools to support cloud native for continuous and progressive deployment of components	Consortium
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5.5.1. KPI status

At project closure (M38), all exploitation KPIs are on track. The business and market analysis completed in the second phase provides a solid evidence base for the final exploitation strategy, aligning technical outputs with concrete market opportunities and ecosystem partnerships. Mature KERs, defined commercialisation routes, and sustained stakeholder engagement collectively demonstrate readiness for post-project uptake and scale.

KPI 3.4.1 – Contributions to Open Source.

Partners have released, maintained, and integrated Open Source components derived from aerOS results. These contributions enable reuse by third parties, reinforce transparency and interoperability, and help cultivate a developer community that can continue to extend the aerOS stack beyond the project's lifetime.

Target: 12 Outcome: 15 Status: Exceeded

aerOS partners have actively contributed to multiple Open-Source communities, exceeding the initial target. Over 15 issues and enhancements were submitted to public repositories such as Orion-LD (ETSI CIM alignment), IOTA, KubeEdge [33], and Morph-KGC, embedding aerOS expertise into widely adopted frameworks. These contributions, while not all aerOS-originated, improve upstream components and ensure broader technological impact.

In parallel, aerOS-specific modules have been extensively documented and included in an Installation Guide. Although not yet fully public, these components are accessible to Open Call #1 projects via controlled GitLab access. Several repositories have been pre-tagged for open-source release under permissive licenses, with the final list and public links to be provided in D5.6. Overall, aerOS has surpassed its KPI target by contributing to and preparing key assets for Open-Source dissemination, strengthening reuse and sustainability beyond the project's lifetime.

KPI 3.4.2 – Business plans, stakeholders, and alliances.

Business plans for all exploitable assets have been completed, detailing value propositions, routes to market, and risk mitigation. Key stakeholders (industry adopters, SDOs, DS/DIHs, and ecosystem partners) have been identified and engaged through targeted outreach and liaison activities, creating a clear pipeline from pilots to sustainable deployment.

Target: 100% Outcome: 100% Status: Achieved

All partners finalised individual exploitation plans, and each pilot consolidated a coherent joint plan, including positioning, IPR treatment, and partner roles, with targeted engagement of relevant stakeholders and alliances.

KPI 3.4.3 – New business lines.

Following market validation and commercialisation analysis, partners have initiated new business lines anchored in aerOS outcomes (e.g., service offerings around orchestration, data management, and privacy-preserving tooling). These lines formalise how results transition from research to recurring revenue and support maintenance of Open Source assets.

Target: 2 Outcome: 2 Status: Achieved

Industrial partners, notably Siemens and TTControl, have integrated aerOS technologies into their respective portfolios—Siemens within its Zero-Defect Manufacturing framework and TTControl in its connected machinery and edge computing services. These integrations have created new or expanded commercial

offerings that leverage edge orchestration, AI-driven analytics, and interoperable services, demonstrating tangible market uptake and the sustainability of aerOS exploitation results.

KPI 3.4.4 – Startup adoption.

Engagement with startups—mentoring, technical onboarding, and integration support—has led to external uptake of aerOS technologies. This early adoption validates technical maturity and portability, while expanding the solution’s reach into new niches and accelerating feedback loops for productisation.

Target: 2 Outcome:11 Status: Achieved

Startups within the aerOS community incorporated aerOS components into their solutions, validating the technology’s suitability for early-stage commercialisation.

The project achieved this status by funding 11 distinct SMEs/Startups across its two Open Calls, significantly surpassing the target of 2. These integrations confirmed the technical maturity of core components, such as the Orchestration Enforcement Layer (ANEOSP) and the Data Fabric's Federation capabilities (AIRCATT) , proving the Meta-OS's portability across diverse industrial vertical

KPI 3.4.5 – Tech-transfer contracts.

The consolidation of mature Key Exploitable Results (KERs), validated pilot performance, and defined commercialisation pathways has created a solid foundation for future technology-transfer activities between research and industry. These actions support the transfer of know-how, IPR, and software components from the consortium to industrial stakeholders, ensuring continuity of aerOS results beyond the project’s lifetime.

Target: 1 Outcome:0 (In progress) Status: In progress

Throughout the final phase, several potential technology-transfer opportunities were identified, particularly within the Manufacturing and Connected Machinery pilots, where industrial partners expressed interest in continuing co-development and integration of aerOS modules into their product lines. While no formal contract has yet been concluded, the established collaboration frameworks and post-project engagement plans provide a clear pathway toward future technology transfer and industrial uptake of aerOS results.

KPI 3.4.6 – Private investments.

The finalized market and ecosystem analysis provides the foundation for expected private investments in aerOS and related open technologies. Although no direct private investments have yet been reported, the consortium has made significant internal efforts and preparatory actions that contribute indirectly to future private funding opportunities.

Given that the current Technology Readiness Level (TRL) of aerOS components is between TRL5 and TRL6, the attraction of external private investors is realistically expected to occur in later stages, once the solutions mature towards full commercial readiness.

In the meantime, several industrial partners have committed internal resources to industrialize, adapt, and integrate aerOS technologies into their product lines, representing indirect private investment. Examples include:

- The opening of new internal R&D lines aligned with aerOS architecture.
- Client-driven initiatives, such as edge containerized data centers and digitalization plans where aerOS modules are evaluated.
- Ongoing business collaborations (e.g., with TTC, OTE, and other partners) that embed aerOS principles into emerging market applications.

To further strengthen this KPI, the consortium plans to carry out market and economic analyses that illustrate the growing private interest in technologies similar to aerOS (e.g., edge computing, data federation, and AI-

driven orchestration frameworks). Additionally, pitching and business validation activities will be explored to showcase the potential for private funding once higher TRL levels are achieved.

Target: €10.0M **Outcome:** 0 (In progress) **Status:** In progress

In summary, while direct private investment has not yet materialized, the foundations for future funding are being actively developed through internal industrial efforts, ecosystem engagement, and strategic alignment with market trends.

KPI 3.4.7 – Market share indicator.

This KPI monitors Europe’s relative position in the global edge–cloud computing market, reflecting aerOS’ contribution to technological sovereignty and industrial competitiveness. While not a direct output KPI, it provides context for assessing the broader market impact and policy alignment of aerOS exploitation results.

Target: 32% , **Outcome:** ~24 % global share (maintained) , **Status:** In progress

According to recent market analyses (e.g., Grand View Research 2024; IMARC Group 2024), Europe currently holds **around 24 % of the global edge–cloud market**, maintaining a steady position despite intensified competition from North America and Asia–Pacific. Within this landscape, aerOS contributes qualitatively by promoting open, modular, and vendor-neutral architectures, strengthening Europe’s innovation capacity and alignment with EU industrial and data-sovereignty strategies. The project’s activities—particularly its open-source releases, SME engagement, and alliances with standardisation bodies (ETSI, AIOTI, 5G-ACIA)—support Europe’s sustained visibility and competitiveness across the edge–cloud continuum.

Table 20 Exploitation KPI Status

KPI#	KPI	Target M38	Outcome M38	Status
3.4.1	# of contributions to OSS projects	12	15	Exceeded
3.4.2	Business plans; stakeholders & alliances engaged	100%	100%	Achieved
3.4.3	New business lines on aerOS by partners	2	2	Achieved
3.4.4	# of startups adopting aerOS as technological baseline	2	11	Achieved
3.4.5	# of tech-transfer contracts signed based on aerOS	1	(0) In progress	In progress
3.4.6	Private investments in aerOS and related open technologies	€10.0M	(0) In progress	In progress
3.4.7	Market share in edge-cloud computing of Europe vs world	32%	~24%	In progress

5.6. Market Analysis

This subsection provides an updated market analysis building on the aerOS D2.1 *State-of-the-Art and Market Analysis Report*. Its primary purpose is to inform the project’s final exploitation plan. The analysis is broad in scope, covering macro-level trends, competitive dynamics, recent EU regulatory developments, and vertical-specific updates relevant to the five aerOS pilots.

The update relies on contemporary data from late 2024 and 2025 to ensure a forward-looking perspective on the evolving market environment. Specifically, it examines:

- **Overall market size and growth** of cloud and edge computing, highlighting convergence trends.
- **Shifts in the competitive landscape**, with emphasis on hyperscalers and opportunities for open-source, vendor-agnostic solutions such as aerOS.

- **EU strategic and regulatory initiatives**, particularly the Data Act [10], which creates strong demand for interoperability and data sovereignty.
- **Vertical market updates** tied to the aerOS pilots, ensuring alignment of project outcomes with sector-specific requirements.

By consolidating these insights, the analysis provides a clear view of how aerOS can be positioned strategically within the European and global edge-cloud continuum markets. This ensures that the exploitation strategy is aligned not only with current conditions but also with the anticipated trajectory of technological and regulatory developments.

5.6.1. Cloud and Edge Computing Market: Size, Growth, and Convergence

The global cloud computing market continues its robust expansion, with diverse sources confirming its significant scale. One source valued the market at USD 676.29 billion in 2024, forecasting a rise to USD 781.27 billion in 2025, with a compound annual growth rate (CAGR) of 16.62% to 2032 [11]. Another report offers a higher valuation, placing the market size at USD 1,125.9 billion in 2024, with a projection to reach USD 1,294.9 billion in 2025, and a 12.0% CAGR to 2030 [12]. This expansion is not uniform across all service models. The public cloud segment held the largest market share in 2024 at 57%, driven by demand for secure and scalable solutions [11]. The Software as a Service (SaaS) segment currently dominates with the highest market share, but Infrastructure as a Service (IaaS) is expected to grow at the highest rate, with a projected 26% market share in 2025, as it minimizes upfront capital expenditures [11].

Simultaneously, the edge computing market is demonstrating explosive growth, fueled by the imperative for real-time data processing and low-latency applications. The market was estimated at USD 23.65 billion in 2024 and is projected to skyrocket to USD 327.79 billion by 2033, exhibiting a remarkable CAGR of 33.0% from 2025 [13]. Another source predicts an even faster pace of growth, with a CAGR of 48.67% from 2025 to 2035 [14]. The hardware segment currently holds the largest revenue share, accounting for over 42% in 2024. However, the software segment is poised for the most rapid expansion, with a projected CAGR of over 37% from 2025 to 2033, as demand for scalable, low-latency software frameworks intensifies [13]. This surge is directly linked to the integration of AI and machine learning models into edge software for localized intelligence and automated decision-making.

The discrepancy in market size figures reported by various research firms is a key indicator of the market's nascent stage. It reflects an industry that is still grappling with consistent definitions for "cloud" and "edge," particularly concerning the inclusion of hardware, software, and services in their valuations. This lack of a monolithic, universally accepted market definition validates the aerOS project's central mission: to create a standardized, horizontal meta operating system that provides a coherent framework for this fragmented landscape. The market's current state of diverse and sometimes conflicting reporting underscores a fundamental need for the kind of unifying platform that aerOS is being designed to be.

The convergence of these markets is now a central theme of digital transformation. The growth drivers for cloud computing, such as the need for operational resilience and digital sovereignty, are directly mirrored in the drivers for edge computing [11]. The deployment of 5G networks and the proliferation of IoT devices are identified as key catalysts for edge computing's expansion, as these technologies demand ultra-low latency and real-time data processing capabilities that a centralized cloud cannot provide alone [13]. This synergy confirms that the edge is not merely an extension of the cloud but a new, essential layer of the computing continuum, and that the market is rapidly moving to build a software and hardware layer that can manage this combined environment effectively.

5.6.2. Correlative Market Growth: AI, IoT, and Telecommunications

The growth of the cloud and edge markets is inseparably linked to the explosive expansion of correlated technologies, particularly AI and the Internet of Things (IoT). The global AI market was valued at USD 233.46 billion in 2024 and is projected to reach USD 294.16 billion in 2025, with a CAGR of 29.20% to 2032 [15]. Another report provides a similar perspective, valuing the market at USD 279.22 billion in 2024 with a projected

CAGR of 35.9% to 2030 [16]. This growth is fueled by massive investments in research and development, particularly in generative AI, quantum AI, and the development of next-generation hardware and software platforms.⁶ A key driver is the application of AI in predictive maintenance, process automation, and supply chain optimization, which are critical for enhancing business operations [16].

Similarly, the IoT market is experiencing a dramatic surge. Valued at USD 59.5 billion in 2024, it is forecasted to reach USD 644.4 billion by 2035 with a CAGR of 24.5% [17]. The European IoT devices market is a significant contributor, with a projected CAGR of 15.9% from 2025 to 2030. [18] Within this market, "Edge Devices" are specifically identified as the fastest-growing segment, highlighting a direct link between IoT proliferation and the demand for edge computing solutions. [18] The EU is actively investing in this sector, as evidenced by a USD 32.5 million loan to a Spanish startup to deploy a constellation of satellites for IoT connectivity, aiming to enhance European sovereignty in space-based IoT infrastructure.

This market environment is characterized by a self-reinforcing dynamic. The exponential growth in the number of IoT devices generates a massive volume of data that must be processed [19]. Sending all this data to a centralized cloud is inefficient and costly, leading to a strong demand for localized processing at the edge. This localized processing is where AI and machine learning models are increasingly being deployed, driving the need for sophisticated edge software platforms and hardware. This confluence of trends—IoT data generation, edge processing, and AI application—creates a perfect storm for a unifying software layer. aerOS's mission to provide an intelligent, orchestrated, and secure platform to manage this entire continuum is directly aligned with the most powerful growth drivers in the digital economy. It is designed to be the foundational software that makes this complex ecosystem of devices, data, and intelligence functional and efficient.

5.6.3. Major Player Strategies: The Hyperscalers' Push to the Edge

The analysis of the competitive landscape reveals that the world's largest cloud providers, often referred to as hyperscalers, are not ceding the edge to smaller, specialized players. Instead, they are pursuing an aggressive strategy of extending their centralized, proprietary cloud ecosystems to the edge. This approach simultaneously validates the market opportunity for edge computing and presents a formidable competitive presence for projects like aerOS.

Amazon Web Services (AWS) is positioning itself as a leader in cloud-native platforms and container management, with services like AWS Lambda, App Runner, and Elastic Beanstalk. Their strategy for the edge-to-cloud continuum revolves around a suite of tools, including AWS Greengrass, which enables businesses to run applications on connected devices, and a broader focus on AI and machine learning through services like Amazon SageMaker [20]. AWS is also making a concerted effort to address the growing demand for sustainability and digital sovereignty. The company has committed to powering its data centers with 100% renewable energy by 2025 and has introduced the AWS European Sovereign Cloud to help customers comply with strict data residency and operational autonomy requirements in the EU [20].

Microsoft Azure is likewise focused on extending its influence to the edge. Its 2025 releases highlight enhanced AI and machine learning capabilities through services like AutoML Pro 2025, which aims to simplify the development and deployment of ML models for non-experts [21]. Azure's platform, Azure Arc, is expanding its reach to provide seamless management across AWS, Google Cloud, and on-premises environments, reflecting a broader strategy to become a central control plane for hybrid and multi-cloud solutions.¹⁵ Furthermore, Azure is making significant investments in IoT and edge computing with tools like Azure Digital Twins, which allow for the creation of digital replicas of physical assets to optimize operations in sectors like manufacturing [21]. The company is also heavily invested in sustainability, with new data centers designed to use renewable energy and AI for increased efficiency.

At **Google Cloud Next 2025**, the company showcased its comprehensive approach to enterprise AI solutions. Google's strategy is centered on providing an end-to-end platform that integrates infrastructure, security, and application development.¹⁶ The company launched the new Ironwood TPU, which boasts a 10x performance increase over its predecessor, and introduced advanced generative AI models like Gemini 2.5 [22]. A key development for the edge-cloud continuum is Agentspace, a new platform for building and managing multi-agent systems, and the Agent2Agent (A2A) Protocol, which enables cross-vendor agent collaboration with platforms like Salesforce and SAP. Google's commitment to sustainability is evident in its investments in sovereign AI systems and the optimization of cooling systems to operate on renewable energy.

These developments from the hyperscalers demonstrate that they are acutely aware of the market's shift to the edge and are leveraging their scale and brand recognition to capture it. Their solutions, however, are fundamentally extensions of their closed, proprietary ecosystems. This competitive dynamic highlights a critical opportunity for aerOS. By positioning itself as an open-source, vendor-agnostic meta operating system, aerOS does not need to compete on a feature-by-feature basis with these giants. Instead, its core value proposition is the promise of interoperability and freedom from vendor lock-in. It can act as the unifying layer that allows enterprises to deploy and orchestrate their applications across a heterogeneous mix of hyperscaler and on-premises resources, a value proposition that is becoming increasingly attractive in a market dominated by a few powerful players.

5.6.4. EU Strategic Initiatives and Regulatory Frameworks: A Tailored Opportunity

The European Union's regulatory landscape has transitioned from a passive set of guidelines to an active, market-shaping force. New regulations, particularly those concerning data and sustainability, are creating a unique and defensible market niche for European-led solutions.

The **EU Data Act**, which took effect in September 2025, is a seminal piece of legislation that fundamentally reshapes how businesses handle data from connected products and digital services. The act grants users—both consumers and business customers—extensive new rights to access, control, and share data generated by their use of connected products. It mandates that providers of data processing services, including cloud and edge computing, must enable easy switching between providers, effectively banning excessive exit fees and contractual clauses that create vendor lock-in. This legislation creates a powerful demand for a solution that is inherently interoperable and platform-agnostic, which is precisely what aerOS is designed to be. The project's open-source philosophy and its focus on data autonomy and seamless service migration directly align with the core tenets of the Data Act, giving it a strong competitive advantage and a compelling narrative for its exploitation strategy.

Complementing the Data Act is the proposed **EU Cloud and AI Development Act**, a strategic initiative aimed at bolstering Europe's high-performance computing capabilities and closing the capacity gap with other global regions. The act seeks to create a unified framework that prioritizes sustainable solutions and addresses the barriers to entry for new players, such as complex permitting processes and high capital intensity.¹⁸ This initiative directly supports aerOS's vision of a sustainable, European-led computing continuum.

In the realm of sustainability, the **Energy Efficiency Directive (EED)** is imposing new requirements on data center operators, mandating them to monitor and report on energy performance and waste heat reuse. Spain, as an example, is taking an even stricter stance by proposing requirements for data centers over 1MW to demonstrate compliance with top-tier performance indicators like Power Usage Effectiveness (PUE) and Water Usage Effectiveness (WUE) and to conduct a cost-benefit analysis for waste heat recovery. This regulatory environment provides a powerful market driver for aerOS's focus on energy-efficient resource orchestration and its renewable energy pilot. The project can be positioned as a solution that not only enhances operational efficiency but also helps enterprises meet increasingly stringent environmental, social, and governance (ESG) compliance standards.

These regulatory changes are not mere obstacles to navigate; they are active forces that are shaping market demand in a way that favors aerOS. The project's open architecture, commitment to interoperability, and focus on sustainability are not just technical features; they are a direct response to a strategic need within the European market. This positions aerOS to be not just a product, but a key enabler of Europe's digital and environmental sovereignty.

5.6.5. Vertical Market Insights: Updates for aerOS Pilots

5.6.5.1. Manufacturing & Production (Pilot: Data-Driven Cognitive Production Lines)

The global smart manufacturing market is experiencing significant growth, with its value reaching USD 349.48 billion in 2024 and projected to grow to USD 394.35 billion in 2025 [19]. This market is anticipated to expand at a compound annual growth rate (CAGR) of 14.2% to 2032 [19]. The primary drivers for this growth are the increasing demand for automation, real-time data analytics, and the rapid advancement of Industrial Internet of Things (IIoT), robotics, and machine learning technologies.

Within this vertical, a critical shift is occurring from simple automation to a more cognitive, data-driven approach. The software segment holds the largest market share and is projected for continued growth, with solutions like Manufacturing Execution Systems (MES) delivering optimized production processes. The reliance on these advanced software solutions for real-time monitoring and predictive maintenance highlights that the primary bottleneck for industrial innovation is no longer hardware, but the software layer that enables data-driven decision-making across disparate systems. The demand for solutions that provide seamless data management and real-time visibility is paramount.

This market dynamic directly aligns with the aerOS pilot. The project is designed to provide the meta operating system required to manage and orchestrate the complex cyber-physical systems of a modern factory floor. By addressing the need for an interoperable system that can manage components and data across machines and information types, aerOS offers a solution to the challenge of technological lock-in and data silos. It can enable real-time data processing and cognitive functions, such as predictive maintenance, by unifying the fragmented software and hardware ecosystems. This approach, as a horizontal enabler, positions aerOS to add significant value by improving operational efficiency, reducing costs, and supporting the push for sustainability and compliance within the manufacturing sector (Table 21)

Table 21 Manufacturing & Production Market Analysis 2025

Feature	2024 Market Size (USD)	Key Drivers (2024-2025)	aerOS Value Proposition
Smart Manufacturing	349.48 billion	Demand for automation and real-time data analytics. Rapid adoption of IIoT, robotics, and ML.	Provides the meta operating system to unify disparate systems, enabling real-time, cognitive data-driven manufacturing and predictive maintenance.
Software Segment	>47.0% of market share	Increasing reliance on advanced software for automation, real-time monitoring, and predictive maintenance.	Offers a horizontal, platform-agnostic software layer to manage and orchestrate complex manufacturing processes across heterogeneous devices.

5.6.5.2. Renewable Energy Sources (Pilot: Containerised Edge Computing)

The renewable energy sector is increasingly reliant on edge computing to manage the variability and complexity of modern power grids. Edge AI algorithms are being deployed in energy infrastructure, such as wind turbines and solar inverters, to analyze sensor data in real-time. This localized processing significantly reduces latency and optimizes bandwidth usage, allowing for immediate actions like load shedding, anomaly detection, and predictive maintenance without relying on cloud commands [23]. The integration of AI for forecasting and optimization is particularly noteworthy, with systems predicting wind and solar output with high accuracy by analyzing real-time data from various sources like weather stations and satellite imagery.

A significant and emerging trend is the physical co-location of data centers with renewable energy sources. Research highlights the feasibility and economic benefits of integrating containerized data centers with offshore wind farms, for example. This model, which bypasses the need for costly high-voltage direct current (HVDC) transmission systems and uses seawater for cooling, is projected to save hundreds of millions of euros on large-scale projects. Furthermore, a "wind-power-aware" policy can be used to route jobs to locations where wind power is available, potentially satisfying over 95% of energy consumption with renewables without delaying job processing [24].

This market shift provides a powerful validation for the aerOS renewable energy pilot. The project is positioned to be the critical software layer that enables the intelligent orchestration of these new, green data center infrastructures. By providing a meta operating system capable of managing distributed, containerized data centers and their workloads in a power-aware and energy-efficient manner, aerOS directly addresses the high energy consumption and carbon footprint of traditional data centers. This aligns perfectly with the EU's push for sustainable, low-carbon digital infrastructure, and it provides a strong business case rooted in both operational efficiency and environmental responsibility (Table 23).

Table 22 Renewable Energy Sources Market Analysis 2025

Feature	2024 Market Size (USD)	Key Drivers (2024-2025)	aerOS Value Proposition
Edge Computing for Energy	>18.6% of market revenue	Need for real-time data processing and low-latency control in smart grids and renewable energy farms.	Provides a meta operating system to intelligently orchestrate containerized data centers, balancing supply and demand from renewable sources in real time.
"Green" Data Centers	No specific data center value in sources	Regulatory pressure for sustainability (EED); cost savings from bypassing HVDC infrastructure.	The aerOS pilot directly addresses this new model, providing the software to enable energy-efficient, distributed computing that leverages renewable energy at its source.

5.6.5.3. Port Continuum (Pilot: Smart Edge Services for the Port Continuum)

The port automation market, driven by the global demand for more efficient, secure, and low-cost logistics, is projected to grow from USD 2.83 billion in 2024 to USD 3.27 billion in 2025, with a CAGR of 15.6% to 2033 [25]. The sector is increasingly adopting AI-based systems and autonomous technologies to improve productivity and reduce emissions [25]. The use of IoT sensors is foundational to this transformation, accounting for 37.1% of the smart port market share in 2024, as these devices transmit real-time data on asset status, weather, and berth conditions.³⁸

Despite this growth, the market faces significant barriers. High initial investment costs and long payback periods (8-10 years) for comprehensive automation solutions are a major deterrent, particularly for smaller ports. Interoperability gaps with legacy systems also present a persistent challenge, as ports are reluctant to replace their existing infrastructure entirely. Edge computing is seen as a key enabler in this context, helping to overcome latency constraints that previously hindered real-time decision-making [26].

The aerOS port continuum pilot is strategically aligned to address these specific market challenges. The project's platform-agnostic meta operating system offers a solution to the interoperability problem by providing a unifying layer that can integrate a wide range of legacy and new systems without requiring a complete overhaul of the infrastructure. By enabling real-time data processing and orchestration at the edge, aerOS can support critical applications like container-spreader alignment and predictive maintenance, directly addressing the need for operational efficiency and reduced downtime. This approach lowers the barriers to entry for smaller ports and offers a more phased, cost-effective pathway to automation, making it a compelling alternative to expensive, custom-built monolithic solutions.

5.6.5.4. Smart Building (Pilot: Energy Efficient, Health Safe & Sustainable Smart Buildings)

The smart buildings market is on a steady growth trajectory, with a projected expansion of USD 76.8 billion between 2025 and 2029, and a CAGR of 11.3% [27]. This growth is largely driven by the adoption of IoT, AI, and 5G networks, which enable a range of advanced applications. Key trends include a shift towards wireless connectivity to reduce costs and improve scalability, and the use of AI and machine learning for predictive maintenance and energy optimization [27]. Edge computing is identified as a crucial component for supporting low-latency applications like security and HVAC control.

However, a primary barrier to market expansion is the lack of interoperability between legacy systems and new technologies. The market is fragmented, with many proprietary solutions that create data silos and prevent unified management. The EU's focus on sustainability, driven by regulations that require retrofitting older buildings to meet energy efficiency standards, is also a significant market driver.

The aerOS project directly addresses these market needs. The project's emphasis on a unifying, platform-agnostic meta operating system is a direct solution to the interoperability issues plaguing the smart building sector. By providing a common layer that can orchestrate services across a heterogeneous mix of devices and systems, aerOS can facilitate the creation of truly integrated building management systems. Furthermore, its focus on energy-efficient resource orchestration and AI-driven optimization aligns perfectly with the market's demand for sustainable solutions and operational cost reductions. This positions aerOS to enable a more cohesive and efficient smart building ecosystem, offering a superior alternative to the current fragmented landscape of proprietary technologies.

5.6.5.5. Cloud and Edge Computing Market: Size, Growth, and Convergence

The autonomous agricultural machinery market is a high-growth sector, projected to exceed USD 15 billion in global value by 2025 [28]. This market is driven by the need for precision farming, increased productivity, and the promotion of sustainable practices [28]. Key technological trends include the integration of AI for autonomous navigation, obstacle avoidance, and predictive maintenance, along with the widespread deployment of IoT sensors for real-time data on soil moisture, nutrient levels, and crop growth [29]. Advanced fleet management tools that use AI optimization and remote monitoring are becoming essential for improving logistics, reducing emissions, and lowering operational costs [29].

A major challenge for this sector is the need for continuous, high-performance connectivity in remote, rural environments, which is often unreliable. The applications, such as platooning and automated control, require ultra-low latency and real-time decision-making, which cannot be guaranteed by a centralized cloud architecture [28].

The aerOS pilot is uniquely designed to address these specific challenges. By focusing on a high-performance computing platform for connected and cooperative mobile machinery, aerOS provides the core technology to enable distributed intelligence. The project's edge-first approach ensures that critical real-time decisions, such as autonomous navigation and control, are processed locally on the machine, circumventing the risks associated with unreliable network connections to a central cloud. The platform-agnostic and secure nature of aerOS allows for the orchestration of a fleet of heterogeneous vehicles, enabling cooperative actions and optimizing their work in an energy-efficient manner. This positions aerOS as a foundational enabler for the next generation of autonomous and sustainable mobile machinery, providing a reliable and robust platform that can operate in the most demanding, low-connectivity environments.

5.6.5.6. Synthesis of Findings

The updated market analysis confirms that the aerOS project is operating in a highly dynamic and expanding market, with the foundational trends identified in D2.1 having accelerated significantly in late 2024 and 2025. The core insights from this analysis are as follows:

- The market for cloud and edge computing is experiencing rapid, sustained growth, driven by a convergence of AI, IoT, and telecommunications technologies. The edge computing software market, in particular, is positioned for explosive growth, underscoring a critical need for a unifying software layer like the one aerOS is developing. The ambiguity in market size reporting for this nascent sector

further indicates the absence of a dominant, standardized solution, creating a clear opportunity for a new entrant.

- The competitive landscape is defined by the aggressive entry of hyperscalers into the edge, which validates the market opportunity but also highlights the need for strategic differentiation. Their solutions are largely extensions of their proprietary ecosystems, a vulnerability that aerOS can exploit with its open-source, vendor-agnostic philosophy.
- The European regulatory environment is a powerful market-shaping force. The EU Data Act's focus on combating vendor lock-in and the Energy Efficiency Directive's new sustainability requirements provide a clear, defensible market niche for aerOS. The project is positioned to deliver not just a technically superior solution, but one that is strategically aligned with Europe's goals for digital sovereignty and green innovation.

Taken together, these findings highlight both the urgency and the opportunity for aerOS to establish itself as a trusted, open, and sustainable solution across multiple sectors. The following section translates this knowledge into specific pilot-specific co-op plans, ensuring that aerOS' positioning is based on practical, sector-specific adoption pathways.

6. Business Analysis – Eclipse aeriOS

6.1. Introduction

The Eclipse aeriOS initiative (previously known as *stratOS/nostOS*) represents the open-source exploitation branch of the aerOS Meta-Operating System (Meta-OS) framework. Its primary objective is to ensure the technological sustainability, long-term visibility, and broad community adoption of aerOS outcomes beyond the project's lifetime. To achieve this, the initiative focuses on the creation of a product encompassing the core aerOS assets—including the orchestration framework, reference APIs, and essential Meta-OS functions—as incubated project inside Eclipse Foundation, where it will be maintained under an Apache 2.0 license (and one MIT-licensed repository) and an open governance model.

This action marks a critical step in transforming aerOS from a project-specific research platform into a pan-European open innovation ecosystem. By leveraging Eclipse's industrial-grade governance, IPR framework, and global developer community, aeriOS guarantees continuity, transparency, and accessibility to both industrial partners and the wider research community. The initiative thus establishes a solid foundation for the long-term evolution of Meta-OS technologies across the IoT–Edge–Cloud–Space continuum. Aligned with the objectives of the **European Open-Source and Digital Sovereignty Strategy [30]**, aeriOS promotes **transparent, standards-based, and vendor-neutral** approaches that prevent technological lock-in and reinforce Europe's strategic autonomy.

The project contributes directly to the **European Cloud-Edge-IoT (EUCEI) [31]** policy vision by providing a **reference implementation** for distributed orchestration, resource federation, and trust-based collaboration among heterogeneous infrastructures.

Within this broader framework, aeriOS is not merely a technical artefact—it is a strategic enabler of European digital autonomy and open innovation. It provides the building blocks for a federated Meta-OS capable of orchestrating distributed intelligence and computational resources across a diverse range of infrastructures, including terrestrial, airborne, and space-based systems. Through its open, modular, and extensible architecture, aeriOS facilitates cross-domain interoperability, AI-driven orchestration, and real-time edge autonomy, bridging the gap between cloud-native computing and embedded systems. Following extensive internal evaluation and several coordination meetings with the Eclipse Foundation's Software and Trademark Teams, the Universitat Politècnica de València (UPV) initiated the formal Eclipse aeriOS project proposal in July 2025 as part of the aerOS open-source roadmap (*Pillar 2 – Incubation*).

This action reflects aerOS's long-term exploitation strategy: transitioning from project-specific development to a sustainable, community-led open-source framework under a trusted European umbrella organization.

The **Eclipse Creation Review**—a mandatory step before full incubation—is currently in progress, covering IP compliance, naming approval, repository setup, and community onboarding. The provisional Eclipse project page, accessible at:  <https://projects.eclipse.org/proposals/eclipse-stratos>, serves as the public entry point for the initiative’s ongoing open-source review process.

Upon completion of this review, **Eclipse aeriOS** will officially enter the **Incubation Phase**, opening its repositories to public contribution, documentation, and industrial pilot adoption—marking the formal start of its life as a sustainable, community-driven open platform at the heart of Europe’s Meta-OS ecosystem.

6.2. aeriOS Concept and Value Proposition

aeriOS functions as a Meta-Operating System (Meta-OS) for the computing continuum, providing a unified, intelligent environment in which distributed workloads can be deployed, orchestrated, and monitored seamlessly across heterogeneous infrastructures—from IoT sensor networks and edge gateways to cloud clusters and space-based processing units. It abstracts the underlying diversity of hardware, network, and administrative domains into a coherent management layer, enabling transparent workload mobility, continuous service availability, and intelligent resource allocation throughout the end-to-end data path.

At its core, aeriOS embodies a new generation of continuum-native orchestration, blending cloud-native scalability, edge autonomy, and federated coordination within a modular and extensible architecture. Its goal is to operationalize the “intelligence everywhere” paradigm, ensuring that applications and data can dynamically adapt to changing conditions, latency constraints, and trust requirements across distributed infrastructures.

To achieve this, aeriOS integrates several advanced mechanisms and architectural pillars:

- **A Two-Layer Orchestration Model:** aeriOS introduces a hierarchical orchestration structure that separates global decision-making from localized execution.
 - The **High-Level Orchestrator (HLO)** manages cross-domain policies, workload distribution, and federation-level coordination.
 - The **Low-Level Orchestrators (LLOs)** operate closer to the physical edge or domain-specific infrastructure, executing deployment, scaling, and fault-recovery tasks. This layered model provides scalability and resilience by decentralizing control, minimizing latency, and allowing local autonomy while maintaining overall system coherence.
- **Domain Federation and Data Interoperability:** Using the Orion-LD Context Broker and NGSI-LD data models (aligned with FIWARE and ETSI standards), aeriOS enables semantic data exchange and context sharing between administrative domains. This facilitates interoperability across heterogeneous environments—public/private clouds, edge clusters, and even mission-specific networks—allowing different operators to collaborate securely without surrendering sovereignty over their data or infrastructure. Federation policies define how resources and applications are shared, discovered, and orchestrated across the continuum.
- **Distributed Decision-Making and Trust-Based Orchestration:** aeriOS incorporates decentralized coordination mechanisms to support trust, traceability, and accountability across multiple domains. Leveraging technologies such as IOTA Tangle (for distributed ledger-based trust management), Keycloak (for federated identity and access control), and a dedicated Trust Manager service, aeriOS provides fine-grained, verifiable control of resources and operations. This enables secure and auditable collaboration between multiple stakeholders while maintaining data integrity and compliance with European cybersecurity standards.
- **Standards-Based APIs and Cloud-Native Integration:** The system is fully compatible with containerized workloads and modern orchestration frameworks such as Kubernetes, Docker, and OpenFaaS. Its open and modular API framework—implemented through REST and OpenAPI specifications—ensures that applications, monitoring agents, and management tools can be easily integrated or extended. This approach aligns aeriOS with the ongoing evolution of cloud-native computing and facilitates integration with existing DevOps pipelines, CI/CD systems, and industrial automation frameworks.

- **Edge-Side Intelligence and Autonomy:** Each Infrastructure Element (IE) within the aeriOS ecosystem hosts a local intelligence layer capable of performing autonomous monitoring, anomaly detection, and dynamic scaling. This decentralization enables edge devices to make context-aware decisions—such as relocating workloads closer to data sources or triggering localized responses to network disruptions—without waiting for cloud-level commands. The result is a self-adaptive computing environment optimized for latency-sensitive, mission-critical, and energy-constrained applications.

Through these integrated mechanisms, aeriOS delivers a unified operational layer that can dynamically orchestrate distributed computing resources and application components in real time, bridging the functional gap between IoT devices, edge computing nodes, cloud infrastructures, and emerging space-based computing assets.

The design philosophy of aeriOS emphasizes neutrality, openness, and extensibility. By adhering to open standards and adopting an Apache 2.0 licensing model, aeriOS avoids the proprietary lock-in that characterizes many commercial orchestration platforms. This makes it particularly suited for European sovereign digital ecosystems, where transparency, interoperability, and trust are key policy requirements. Furthermore, the modular nature of its architecture allows integration of domain-specific modules—ranging from AI-driven optimization and telemetry analytics to cybersecurity compliance and digital twin synchronization—enabling aeriOS to evolve alongside industrial and research needs.

In essence, aeriOS represents a meta-layer of intelligence over the existing computing continuum:

- It connects diverse infrastructures,
- coordinates distributed workloads, and
- enables secure, autonomous operation across federated domains.

By doing so, it positions itself as a strategic European Meta-OS reference implementation, bridging the gap between technological innovation and sustainable open governance under the Eclipse Foundation.

6.3. Eclipse Incubation Process and Actions

The **UPV team**, as an Associated Member of the Eclipse Foundation, coordinates the creation and incubation of aeriOS.

Key actions completed since the **Milan Plenary (May 2025)** include:

- Drafting and submission of the Eclipse aeriOS project proposal and descriptive materials.
- Engagement with the Eclipse Software and Trademark teams to resolve naming and dependency issues.
- Preparation of communication and dissemination materials, including perceptual market maps and competitor analysis.
- Participation in relevant community events (AIOTI Days, OSCD) to present the Meta-OS vision.
- Identification of licensing models (Apache 2.0 for most repositories, MIT for EAT).
- Dependency clearance and analysis:
 - *Orion-LD* use approved.
 - *Redpanda* may be substituted by *NATS* for broader compliance.
 - *Wireguard* licensing impact under review (potential derivative work analysis).

A working OSS register has been shared on aerOS NextCloud for all partners to document contributions and licensing declarations, with a submission deadline of 28 October 2025.

Next Steps

The following actions have been defined to ensure timely progress toward the consolidation and dissemination of the aeriOS project. Each partner is assigned specific responsibilities with corresponding target dates to secure alignment across technical, marketing, and coordination activities.

Table 23 *aeriOS Next Steps*

Action	Responsible Partner	Deadline
Accelerate the product creation process	UPV	ASAP
Modify the codebase to overcome the dependencies issues	UPV	ASAP
Create the new version of perceptual maps and the positioning of the project	FOGUS	28th October 2025
Generation of promotion material for the aerOS OSS product using the new name: aeriOS	NASERTIC	7th November 2025
Apply the promotional actions as per the plan	INFOLYSIS	Sept & Oct 2025

6.4. Relation to Other Meta-OS Initiatives

The aeriOS initiative is aligned with, and complementary to, several ongoing **Eclipse and EU Meta-OS efforts**, including:

Table 24 *Matrix Relation to Other Meta-OS Initiatives*

Description	Relevance to aeriOS	Description
Eclipse ioFog / Fog05	Edge orchestration frameworks focused on container and service deployment at the edge.	aeriOS extends these concepts to multi-domain federation and trust-aware orchestration.
Eclipse Kapua	IoT cloud platform for device data management and analytics.	aeriOS complements it with distributed computing and continuum orchestration.
Eclipse Zenoh	Data space and pub/sub for IoT-edge-cloud.	Potential interoperability layer for aeriOS telemetry and messaging.
EUCEI TF3 Architecture	European Cloud-Edge Continuum initiative defining Meta-OS interoperability.	aeriOS is designed in full alignment, ensuring EU-wide compatibility.
Nebulous / ICOS / NEPHELE Projects	EU-funded Meta-OS research initiatives.	aeriOS can act as an open, Eclipse-hosted reference implementation bridging these efforts.

Through these relationships, aeriOS positions itself as a **European, open, and interoperable Meta-OS** platform under Eclipse governance, ensuring long-term sustainability beyond the aerOS project lifecycle.

6.5. Objectives of the Business Action

Objectives of the Business Action The Eclipse aeriOS Business Action represents a strategic exploitation pillar of the aerOS open-source roadmap, translating technical results into a sustainable, community-driven framework for long-term impact. It bridges the gap between research innovation, industrial adoption, and open governance, ensuring that the Meta-Operating System (Meta-OS) developed within aerOS continues to evolve, expand, and create value well beyond the project's completion.

The specific business and strategic objectives are structured into five main axes:

1. Open-Source Transfer and Governance

The first and foundational objective is the full open-source transition of the aerOS Meta-OS framework to the Eclipse Foundation, a trusted European hub for open digital infrastructure. This transfer aims to guarantee continuity, transparency, and shared ownership across the industrial and research ecosystem.

Key actions include:

- **Migration of Core Assets:** Complete transfer of the aerOS codebase, documentation, and build environments to Eclipse-hosted repositories, ensuring compliance with the Eclipse IP and Security Review Process.
- **Open Governance Establishment:** Implementation of an open community development model under the Eclipse Open Community with well-defined roles for committers, maintainers, and contributors.
- **Legal and IPR Framework Alignment:** Alignment of existing aerOS intellectual property under the **Apache 2.0 license**, ensuring compatibility with partner contributions and future industrial integration.

Through these actions, the project establishes **Eclipse aeriOS** as a legally robust, technically credible, and transparently governed open-source initiative.

2. Branding and Market Visibility

The second axis focuses on positioning and brand consolidation. The transition from the internal research names stratOS/nostOS to Eclipse aeriOS marks a key step in transforming the framework into a recognisable and sustainable European brand.

Actions include:

- **Brand Finalisation:** Finalize the aeriOS naming, visual identity, and brand guidelines in collaboration with the **Eclipse Marketing and Communications Teams**. This ensures coherence with Eclipse's naming conventions and improves recognisability within the global open-source community.
- **Strategic Positioning:** Position aeriOS as the **European reference Meta-OS under Eclipse governance**, representing Europe's leadership in open continuum computing.
- **Visibility and Outreach:** Disseminate aeriOS across key European and international forums, to attract both industrial adopters and contributors.

This branding and outreach strategy will ensure that aeriOS becomes synonymous with trustworthy, sovereign, and interoperable open technologies for the computing continuum. The next subsection outlines the progress achieved in the rebranding so far.

6.6. Branding and Marketing Material of ECLIPSE aeriOS

As part of the business model definition for the ECLIPSE aeriOS product, a series of actions have been performed to engage early with the community and potential commercial adopters of the technology in the future.

In the scope of task T6.4, a suite of materials have been prepared to enhance the branding and marketing capacity for this new initiative. In particular, the partner NASERTIC has been collaborating in the task by delivering the following items:

- Definition of a **logo for the product**. This was achieved after a discussion process, where all committers (coming from aerOS Consortium) expressed their preferences. The final logo selected was as illustrated below. Three different layout versions were designed (squared, horizontal and vertical), and different rendering has also been provided in both .png and .eps (vectorial format):



Figure 40 aerIOS logo

- An **informative flyer**, including a summary of the technological coverage of aerIOS, as well as the background it is coming from, and the inclusion inside ECLIPSE incubation program:



Figure 41 aerIOS flyer

- A **decorative “cube”** structure to bring to fairs and events, based on Adobe Illustrator design, Once printed and mounted, it will look like the second figure below.



Figure 42 aerIOS decorative “cube”

- A “corporate” slide deck for pitching and informing about aerIOS technology, scope and background. It is composed of six slides, following a clear color palette and theme, with sections: (1) About Us, (2) Background, (3) Key Points and (4) Contact.



Figure 43 aerIOS slide deck

3. Ecosystem Development and Industrial Engagement

The success of aerIOS depends on the strength of its ecosystem—a network of partners, adopters, and integrators that contribute to its growth and sustainability. Therefore, the business action prioritises ecosystem expansion through both European alliances and industrial collaborations.

Actions include:

- **Strategic Partnerships:** Engage with European and global stakeholders such as **Standards Development Organisations (SDOs)**, **industrial clusters**, and **EU projects** (Nebulous, ICOS, NEPHELE, NEMO, and EUCEI TF3). This ensures alignment with ongoing initiatives in Meta-OS standardisation and cloud-edge interoperability.
- **Community Building:** Establish a **community of adopters, contributors, and integrators**, leveraging Eclipse’s open collaboration model to attract developers and domain experts.

- **Industry Collaboration:** Strengthen relations with industrial actors, enabling early trials and demonstration activities that showcase aeriOS in real-world environments.

Through these coordinated efforts, aeriOS will evolve from a research prototype into a living industrial ecosystem, serving as the backbone of future European digital autonomy.

4. Commercial and Research Synergy

The fourth objective links the open-source exploitation path with commercial and research-driven opportunities, allowing the aerOS partners to derive long-term value from aeriOS.

Actions include:

- **Commercial Enablement:** Enable project partners to deliver **integration, consultancy, and support services** around the aeriOS framework. This includes custom deployments, interoperability audits, and AI/Edge solution integration.
- **Research Continuity:** Use aeriOS as a baseline for participation in future European Commission, and industrial tenders in domains such as AI@Edge, Digital Twins, Federated Cloud, and Cybersecurity for Continuum Systems.
- **Cross-Project Collaboration:** Align aeriOS with other open Meta-OS research projects to build a federated knowledge base and shared reference implementations for the EU continuum computing vision.

This synergy ensures that aeriOS remains both an **open scientific reference** and a **commercially viable platform**, accelerating adoption across multiple verticals.

5. Sustainability and Exploitation Continuity

The final objective ensures that aeriOS remains **operational, evolving, and community-driven** long after the aerOS project concludes.

Actions include:

- **Long-Term Maintenance:** Guarantee continuous updates and issue management via Eclipse's Long-Term Support (LTS) channels and community contributors.
- **Eclipse Membership Leverage:** Maintain active participation of partners through Eclipse Working Groups (e.g., Edge Native, IoT, AI), ensuring synergy with parallel initiatives.
- **Funding and Investment Channels:** Explore additional sustainability mechanisms such as sponsorship programmes, public-private partnerships, and joint development agreements (JDAs) with industrial adopters.

Together, these efforts ensure technical sustainability, economic viability, and community vitality, establishing Eclipse aeriOS as a flagship European open-source infrastructure project.

Meta-OS Market Context

The Meta-OS landscape is currently shaped by a combination of academic prototypes, vertical industrial frameworks, and community-driven orchestration stacks. While many initiatives focus on isolated aspects—such as cloud orchestration, edge runtime, or IoT integration—none fully unifies federation, trust, and intelligent continuum orchestration under an open governance model.

Eclipse aeriOS differentiates itself by combining these dimensions into one coherent and extensible ecosystem Table 26, offering an open, standards-based alternative to proprietary solutions.

Table 25 Segment Landscape & aeriOS Differentiation

Segment	Representative Solutions	Differentiation of aeriOS
Cloud Orchestration	Kubernetes, OpenStack	aeriOS extends orchestration to edge, IoT, and space, with cross-domain federation
Edge Frameworks	Eclipse Fog05, ioFog, EdgeX Foundry	aeriOS adds federated coordination, security, and trust layers
IoT Platforms	Eclipse Kapua, Fiware Orion LD	aeriOS integrates data context and computing resources for real-time distributed control
Meta-OS Projects (EU)	Nebulous, ICOS, NEPHELE, NEMO	aeriOS serves as the open Eclipse reference platform ensuring interoperability
Commercial Platforms	AWS Greengrass, Azure IoT Edge [35]	aeriOS provides an open, sovereign European alternative without vendor lock-in

6.7. Market Opportunity

The European Cloud–Edge–Continuum market is expected to surpass €5 billion by 2027, driven by the growth of AI@Edge, real-time analytics, cyber-physical systems, and federated orchestration frameworks. Eclipse aeriOS is strategically positioned to address this market by offering a trustworthy, open, and standard-compliant Meta-OS—bridging technical innovation with digital sovereignty and industrial competitiveness.

Through its open governance model, industrial collaborations, and alignment with European policy priorities, aeriOS is set to become a cornerstone of Europe’s next-generation distributed computing ecosystem.

6.7.1. Perceptual Maps for ECLIPSE aeriOS

A perceptual map is a powerful tool that helps to visualize how consumers or stakeholders understand a brand compared to competitors. This map could be in a 2D (two-dimensional) and in a 3D (third dimension) format. The most common type is the 2D map, which is the one used in aeriOS (aerOS open-source solution) for most efficient presentation. This approach simplifies market research, identifying gaps between the competitors and highlighting the strengths of aeriOS with an easy-to-read format. The steps that were followed for the creation of the perceptual map are:

- Identify key competitors/alternatives
- Determine the most important attributes for comparison
- Determine our product’s position
- Place competitors

The first step of the creation of a perceptual map is the identification of the key competitors. The edge computing and cloud infrastructure market offers various platforms. Each platform provides unique capabilities and targets different aspects of distributed computing. To create an accurate perceptual map and position our solution effectively, the following is a list of key competitors that are available to potential users.

OpenNebula [32] is an open-source cloud computing platform for managing heterogeneous data center, public cloud and edge computing infrastructure resources.

KubeEdge [33] is an open-source system for extending native containerized application orchestration capabilities to hosts at Edge.

Red Hat OpenShift (Edge) [34] is an industry-leading enterprise containers and Kubernetes application platform with full-stack automated operations to manage hybrid cloud, multicloud, and edge deployments.

Google Distributed Cloud Edge (GDCE) [36] is an on-premises solution distributing the power of the cloud in the location of the equipment.

Azure IoT Edge [35] indicates a device-focused runtime that enables you to deploy, run, and monitor containerized Linux workloads, bringing analytics closer to your devices for faster insights and offline decision-making.

EdgeX Foundry is an open-source platform that facilitates interoperability between devices and applications at the IoT edge.

Perceptual Maps

Next step was to identify the key attributes of aeriOS use case to compare with the existing solutions. Since aeriOS have a variety of those attributes, different versions of perceptual maps were contacted, so all of them could be included. Each map provides axes descriptions, and positioning justifications for all competitors.

Perceptual Map Version 1

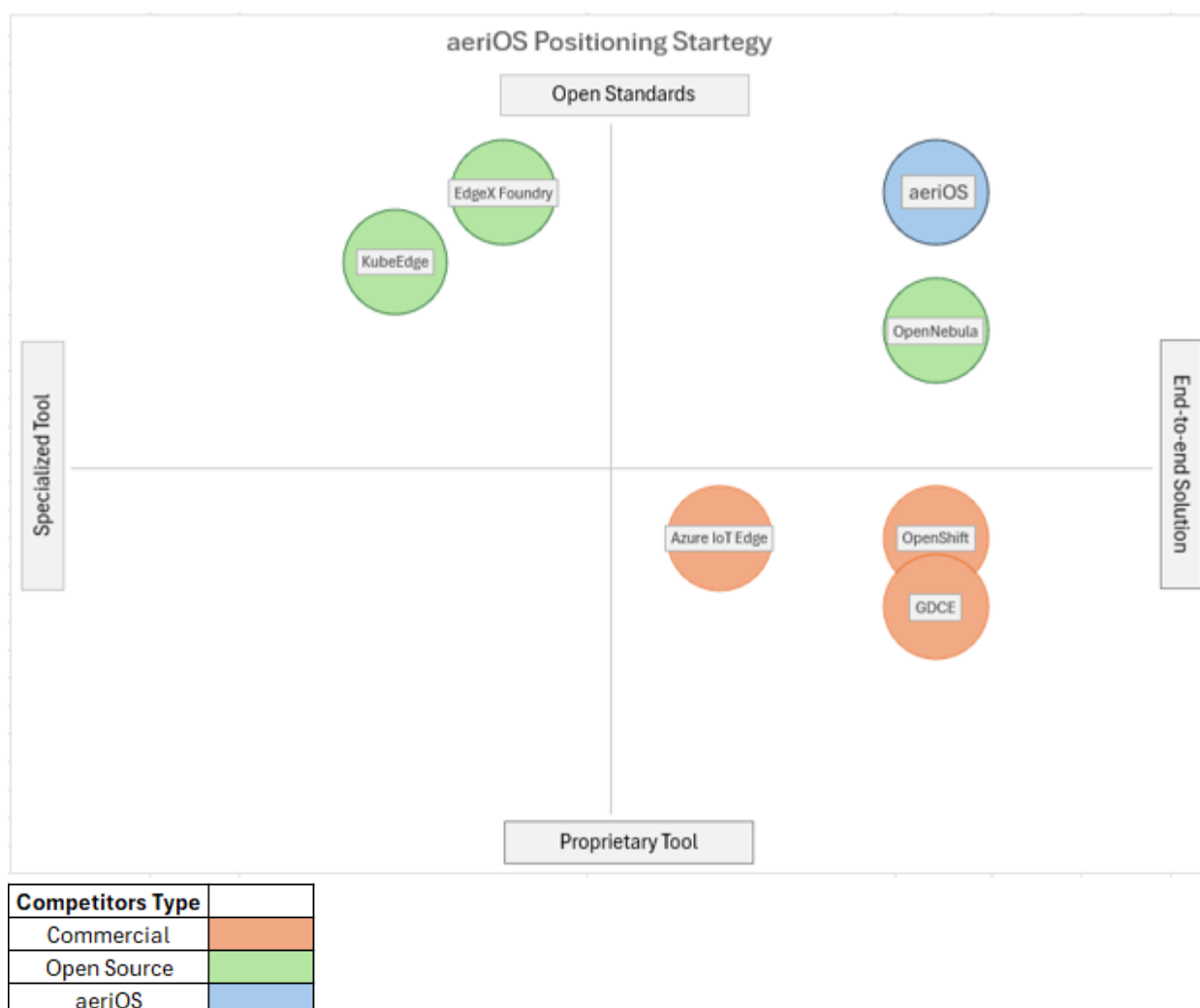


Figure 44 Perceptual map

Axes Description

Specialized Tool → End-to-end Solution: Describes the functionality range of each platform. Specialized tools cover specific use cases (e.g. IoT pipelines or orchestration), while End-to-end platforms provide orchestration, observability, trust, UI and lifecycle management.

Proprietary Tool → Open Standards: This axis shows the way that a user depends only on services from a single provider. Vendor lock-in limits flexibility through proprietary tools, while open standards allow easy integration, portability, and freedom of choice.

Table 26 Positioning Justification

Platform	Specialized Tool → End-to-end Solution	Proprietary Tool → Open Standards
aeriOS	aeriOS implements a Meta-OS for the computing continuum, from IoT to cloud. It orchestrates containerized workloads, provides access control, monitoring, self-automation, trust/security, and a web-based GUI, forming a scalable, federated, and decentralized solution.	aeriOS relies on using de-facto standard communication technologies, such as HTTP REST APIs, OpenAPI documentation, solid data formats such as NGSI-LD and tunnelling based on Fully-Qualified-Domain-Names for required networking (employing Wireguard VPNs). Also, due to inheriting from a research project, it aligns with impactful on-going initiatives, such as the TF3 Architecture from EUCEI.
OpenNebula [32]	OpenNebula [32] provides unified management of IT infrastructure and applications and enables you to run any application (Virtual machines or Kubernetes containers) seamlessly on bare-metal infrastructure across on-premises, public cloud, and edge environments. The platform allows organizations to combine private, public, and edge cloud operations under a single control panel and interoperable layer.	OpenNebula [32] is Apache-licensed Open-Source Software and offers two different remote cloud interfaces, OCCI and EC2. The platform supports terraform resources and includes ansible playbook to configure physical servers, with Ansible system package installed as a dependency of the OpenNebula [32] provision package. However, it does not support modern semantic standards like NGSI-LD and is not aligned with modern edge computing frameworks like TF3 Architecture.
KubeEdge [33]	KubeEdge [33] is built upon Kubernetes and extends native containerized application orchestration and device management to hosts at the Edge. It provides core infrastructure support for networking, application deployment and metadata synchronization between cloud and edge and supports MQTT and allows developers to author custom logic and enable resource constrained device communication at the Edge. However, it is fundamentally a Kubernetes extension rather than a complete platform.	KubeEdge [33] is under the Apache 2.0 license and recently moved to the Graduated maturity level as a CNCF project. It is built upon Kubernetes and provides fundamental infrastructure support for network, application deployment and metadata synchronization between cloud and edge, though this means it is tied to the Kubernetes ecosystem.
Red Hat OpenShift (Edge) [34]	Red Hat OpenShift is a unified application development platform that lets you build, modernize, and deploy applications at scale on your choice of hybrid cloud infrastructure. It offers integrated platforms and tools that let you consistently and efficiently deploy, manage, and protect workloads at scale from core to edge.	Red Hat OpenShift is a certified Kubernetes powered application platform, a commercialized software product built based on multiple open-source projects. It provides an ArgoCD for cluster configuration and supports GitOps workflows. However, Red Hat Enterprise Linux CoreOS (RHCOS) is the only supported operating system for OpenShift Container Platform control plane,

		creating dependency on Red Hat's ecosystem.
Google Distributed Cloud Edge (GDCE) [36]	Google Distributed Cloud Edge enables you to run Google Kubernetes Engine (GKE) clusters on dedicated hardware provided and maintained by Google and empowers communication service providers to run workloads on Intel and NVIDIA accelerated hardware to deliver new 5G and edge use cases. It integrates with Google Cloud services such as AI, machine learning, and data analytics while running closer to end-users providing end-to-end Google Distributed Cloud solutions.	Google Distributed Cloud Edge executes Kubernetes workloads on dedicated hardware running on customer premises with Anthos managing GKE clusters across environments. However, the multiple components fall under control of Google, not another cloud provider or integrator, creating significant vendor lock-in with no support for broader open standards.
Azure IoT Edge [35]	Azure IoT Edge [35] is a device-focused runtime that enables you to deploy, run, and monitor containerized Linux workloads. It remotely and securely deploys and manages cloud-native workloads to run directly on your IoT devices. However, the platform is specifically designed for IoT scenarios and lacks the comprehensive orchestration and federation capabilities that exist in broader edge computing platforms.	The IoT Edge runtime is open-source under the MIT license to give you more control and flexibility with the code. However, customers will need an Azure IoT Hub instance for edge device management and deployment, and all modules are deployed to IoT Edge devices through Azure services. While the runtime is open, operational management requires complete Azure ecosystem integration with no support for broader federation standards.
EdgeX Foundry	EdgeX Foundry is a highly flexible and scalable open-source edge platform that facilitates interoperability between devices & applications at the IoT Edge. Modular architecture allows developers to integrate and manage devices and services efficiently. However, due to the absence of container orchestration technology, such as automated deployment and dynamic resource management for application services, EdgeX Foundry has fundamental limitations of a potential edge computing platform.	EdgeX Foundry is an open software platform, providing more options relative to proprietary solutions. It is platform agnostic and independent of hardware, operating system, software, and cloud. It features plug and play distributed microservices software architecture as an open-source project hosted by The Linux Foundation building a common open framework for IoT edge computing.

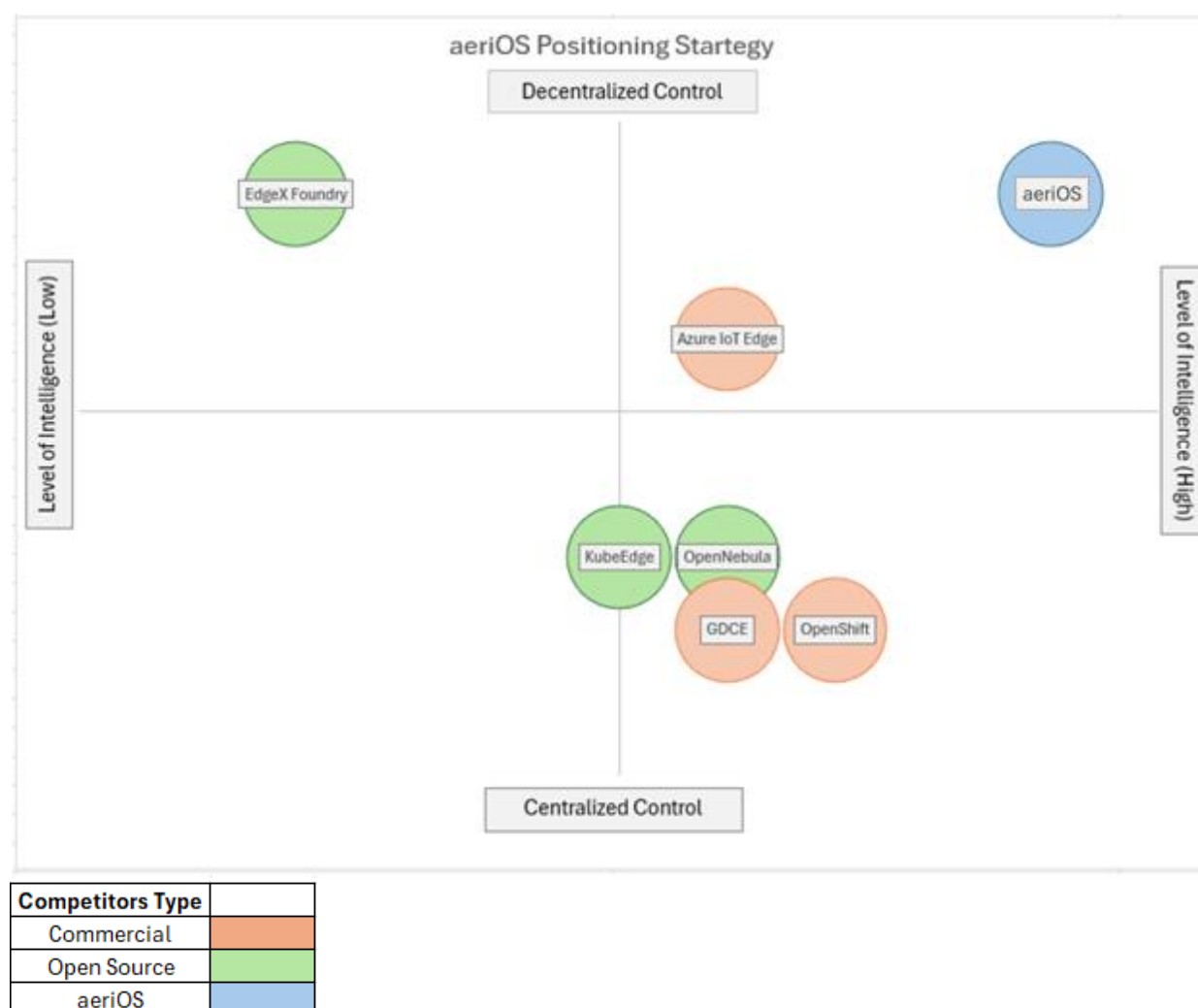


Figure 45 Perceptual Map Version 2

Axes Description

Level of Intelligence: This axis highlights the level that edge nodes can autonomously adapt, detect anomalies or adjust behavior locally

Centralized Control → Decentralized Control: Shows whether control is managed centrally (e.g., from the cloud) or distributed to local orchestrators and edge nodes.

Table 27 Positioning Justification

Platform	Level of Intelligence	Centralized Control → Decentralized Control
aerOS	aerOS nodes are no longer passive elements: they can trigger local orchestration notifications, scale horizontally, detect anomalies, and adapt sampling frequency to circumstances.	aerOS supports a federated orchestration model with autonomous, decentralized decision-making and fine-grained resource control. Thanks to balancing algorithms, requests are handled in different spots, avoiding single point of failure effects.

OpenNebula [32]	OpenNebula [32] delivers smart workload placement, dynamic resource balancing, and predictive optimization. Through OneDRS enables workload migration based on customizable automation thresholds, time-series monitoring, and smart capacity planning. The platform leverages AI and ML to enhance observability, automatic workload placement, and predictive decision-making across your cloud. However, these intelligent features operate centrally, with edge nodes following directives rather than making autonomous local decisions about anomaly detection or adaptive behavior.	OpenNebula [32] keeps control centralized at the master level. There's no autonomous behavior happening at edge nodes.
KubeEdge [33]	KubeEdge [33] supports local caching, enabling edge applications and devices to continue operations during cloud disconnections, with autonomous operation of edge even during disconnection from cloud. It provides node metadata persistence provides node autonomy when nodes are disconnected. However, there is no evidence of built-in anomaly detection or adaptive sampling capabilities.	In the KubeEdge [33] architecture, the cloud is a unified control plane, which includes native Kubernetes management components. It provides autonomous operation of edge even during disconnection from cloud, this focuses on maintaining operations during network issues rather than decentralized decision-making.
Red Hat OpenShift (Edge) [34]	Red Hat OpenShift Operators automate the creation, configuration, and management of instances of Kubernetes-native applications. It provides self-healing infrastructure capabilities that help organizations reduce operational toil and improve reliability. The Red Hat build of MicroShift is a lightweight Kubernetes container orchestration solution for small, resource-constrained devices at the farthest edge. However, there is no evidence of capacity-driven orchestration or adaptive sampling capabilities that would enable truly intelligent edge behavior.	Red Hat Advanced Cluster Management provides a single console for controlling Kubernetes clusters and applications with centralized visibility, control and governance across hybrid and multi-cloud environments. The OpenShift Container Platform GitOps applies resources directly from a centralized hub cluster to the managed clusters. While MicroShift has been specifically designed for edge computing use cases, the overall architecture remains centralized rather than autonomous edge decision-making.
Google Distributed Cloud Edge (GDCE) [36]	Google Distributed Cloud Edge integrates with Google Cloud services such as AI, machine learning, and data analytics while running closer to end-users. It supports disconnected mode for up to seven days with workloads continue to run while disconnecting from Google Cloud using a local control plane on your hardware. However, there is no evidence of node-level adaptive sampling or autonomous anomaly detection capabilities.	Google Distributed Cloud Edge uses a centralized control and management plane with a cloud-backed control plane that provides a consistent management experience at scale. Google or a Google-certified SI provides, deploys, operates, and maintains the dedicated hardware with remote management by a dedicated Google team. Even during offline periods, control remains centrally governed by Google's cloud infrastructure.
Azure IoT Edge [35]	Azure IoT Edge [35] deploys artificial intelligence and custom logic to IoT devices and helps you bring the analytical power of the cloud closer to your devices to drive better business insights and enable offline	Azure IoT Edge [35] provisioning requires registering the device in an IoT hub, which creates a cloud identity that the device uses to establish the connection to its hub. The centralized control of Azure Edge lies in

	decision making. The edge device can function in offline mode indefinitely after initial sync. However, there is no evidence of devices self-monitoring their capacity or triggering orchestration decisions - there's no built-in adaptive behavior beyond running pre-deployed AI models.	managing the Internet of Things solutions and devices through Azure services. While devices can work offline temporarily, all deployment, configuration, and security decisions are cloud-configured through Azure Hub.
EdgeX Foundry	EdgeX Foundry enables data to travel northwards towards the cloud or enterprise for processing and includes a microservice metrics/telemetry collection capability to ease the monitoring of EdgeX services. However, there is no evidence of built-in anomaly detection, adaptive sampling, or autonomous intelligent behavior. EdgeX focuses on data collection and normalization rather than intelligent edge decision-making.	EdgeX Foundry is platform agnostic about deployment/orchestration (Docker, Snaps, K8s, roll-your-own) but provides no built-in orchestration. Deployments and configurations require third-party tools or manual coordination. There's no native control system, centralized or decentralized.

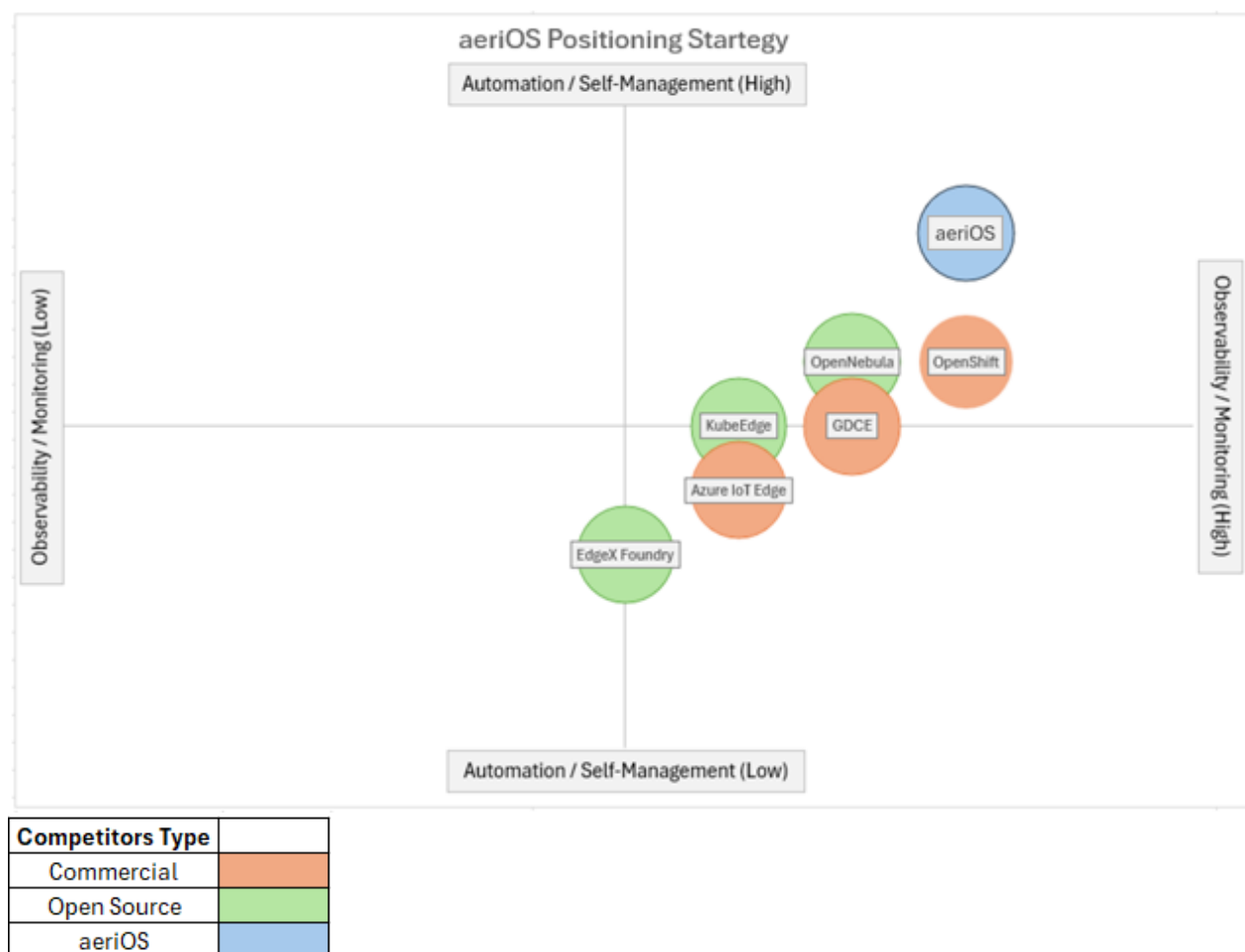


Figure 46 Perceptual Map Version 3

Axes Description

Observability/Monitoring: Evaluates how well a platform provides real-time metrics, system health, and visibility, especially at the edge.

Automation/Self-management: Indicates the degree of automatic operation, scaling, fault recovery, or behavior adaptation without manual intervention.

Table 28 Positioning Justification

Platform	Observability/Monitoring	Automation/Self-management
aeriOS	aeriOS gathers real-time data on resource capabilities and availability using Prometheus or customized scripts running on all Infrastructure Elements and includes continuous monitoring capacities at the edge. The system provides a unified management portal that allows observing the computing resources and the deployed services.	aeriOS nodes are able to trigger local orchestration notifications (e.g., to offload if saturated), scale horizontally, detect anomalies on data or on their behavior, and to adapt the sampling frequency to certain circumstances. The system emphasizes that nodes are no longer passive elements that take orders and incorporates self-automation capacities at the edge.
OpenNebula [32]	OpenNebula [32] 's Prometheus integration provides comprehensive metrics for virtual machines and underlying infrastructure with Grafana dashboards to visualize VM, Host, and OpenNebula [32] information. The Enterprise Edition includes a pre-configured Prometheus instance with metrics tailored for optimal observability with alert management. The monitoring is mature and production-ready, though metrics focus on cluster-level visibility without edge-local intelligence capabilities.	OneDRS automatically balances virtual machines across hosts based on resource usage, using live migration to redistribute workloads intelligently with Predictive DRS using resource usage forecasts to provide proactive migration recommendations. The platform supports Service Role's cardinality adjusted manually, based on metrics, or based on schedule. However, automation remains centralized and administrator-configured through policies and thresholds, without node-level self-triggering or adaptive behavior based on local conditions.
KubeEdge [33]	KubeEdge [33] relies on standard Kubernetes monitoring tools and requires manual setup of observability pipelines. You can use Prometheus for metrics, but there's no built-in edge-specific monitoring or local intelligence. Basic device synchronization works, but observability capabilities are limited compared to full platforms.	KubeEdge [33] allows users to monitor app and device status on Edge nodes just like a traditional Kubernetes cluster in the Cloud using standard tools like metrics-server for collecting metrics. It provides fundamental infrastructure support for metadata synchronization between cloud and edge. However, KubeEdge [33] relies on manual setup of Kubernetes-native observability tools like Prometheus, with no built-in edge-specific monitoring or local intelligence capabilities.
Red Hat OpenShift (Edge) [34]	OpenShift Container Platform includes a pre-configured, pre-installed, and self-updating monitoring stack based on the Prometheus open source project and its wider ecosystem with Prometheus for systems as well as service monitoring, and Grafana for analyzing and visualizing metrics. Red Hat Advanced Cluster Management enables the observability service operator to monitor the health of managed clusters" providing multi-cluster observability capabilities. The	Red Hat OpenShift Operators automate the creation, configuration, and management of instances of Kubernetes-native applications with OpenShift GitOps enabling declarative git driven CD workflows. The platform auto-heals applications when Argo CD detects differences from the Git repository and supports zero-touch provisioning, GitOps, and policy management. However, automation remains centralized and policy-

	monitoring stack is comprehensive and enterprise-grade, though focused on centralized visibility rather than edge-local intelligence.	driven rather than locally adaptive or self-triggered at individual edge nodes.
Google Distributed Cloud Edge (GDCE) [36] [36]	GDCE provides powerful cloud-based observability through Google Cloud Console and Anthos monitoring. You get comprehensive visibility and integration with Google's monitoring stack, but it's entirely cloud-driven. Edge nodes don't contribute much local intelligence to the observability picture.	Google remotely monitors and maintains your Distributed Cloud installation, which includes installing software updates and security patches, resolving configuration issues, and diagnosing the Distributed Cloud hardware. The platform supports cloud-native network automation with Gemini's advanced capabilities unlocking automation, content generation, and discovery on-premises. However, automation is entirely Google-managed and centrally controlled, without node-level self-triggering or local adaptive behavior.
Azure IoT Edge [35]	Azure IoT Edge [35] ensures that IoT Edge modules are always running and reports module health to the cloud for remote monitoring. The platform enables users to remotely monitor IoT Edge devices at scale with Azure Monitor integration using built-in metrics and visualizations to gain deep visibility into the health and performance of your edge applications right in the Azure portal. While Azure IoT Edge [35] delivers robust monitoring, it remains cloud-centric and observability is limited to the Azure ecosystem.	The IoT Edge runtime installs and updates workloads on the device, ensures that IoT Edge modules are always running and maintains Azure IoT Edge [35] security standards on the device. IT offers zero-touch provisioning of edge devices and an Automatic Device Configuration Service for scaled deployment and configuration of edge devices. Azure IoT Edge [35] device management automatically syncs the latest state of your devices after they're reconnected to ensure seamless operability. All automation logic comes from the cloud through Azure services.
EdgeX Foundry	EdgeX does not come with native observability capabilities but makes telemetry data available via message bus, allowing integration with external tools like Prometheus, InfluxDB/Grafana, or DataDog. Service metrics are published to the EdgeX MessageBus every configured interval, requiring adopters to build custom monitoring infrastructure. EdgeX demands additional effort to subscribe and process telemetry data for real-time system visibility.	EdgeX allow services to scale up and down based on device capability and use case, but was not designed to fully operate in a multi-cluster environment and take advantage of a full K8s environment for automatic scaling. Deployment and orchestration systems (Docker Compose, Kubernetes, etc.) provide for the ability to start, stop, and restart the EdgeX services. It relies on external orchestration tools for automation and lacks native fault recovery or adaptive behavior features.

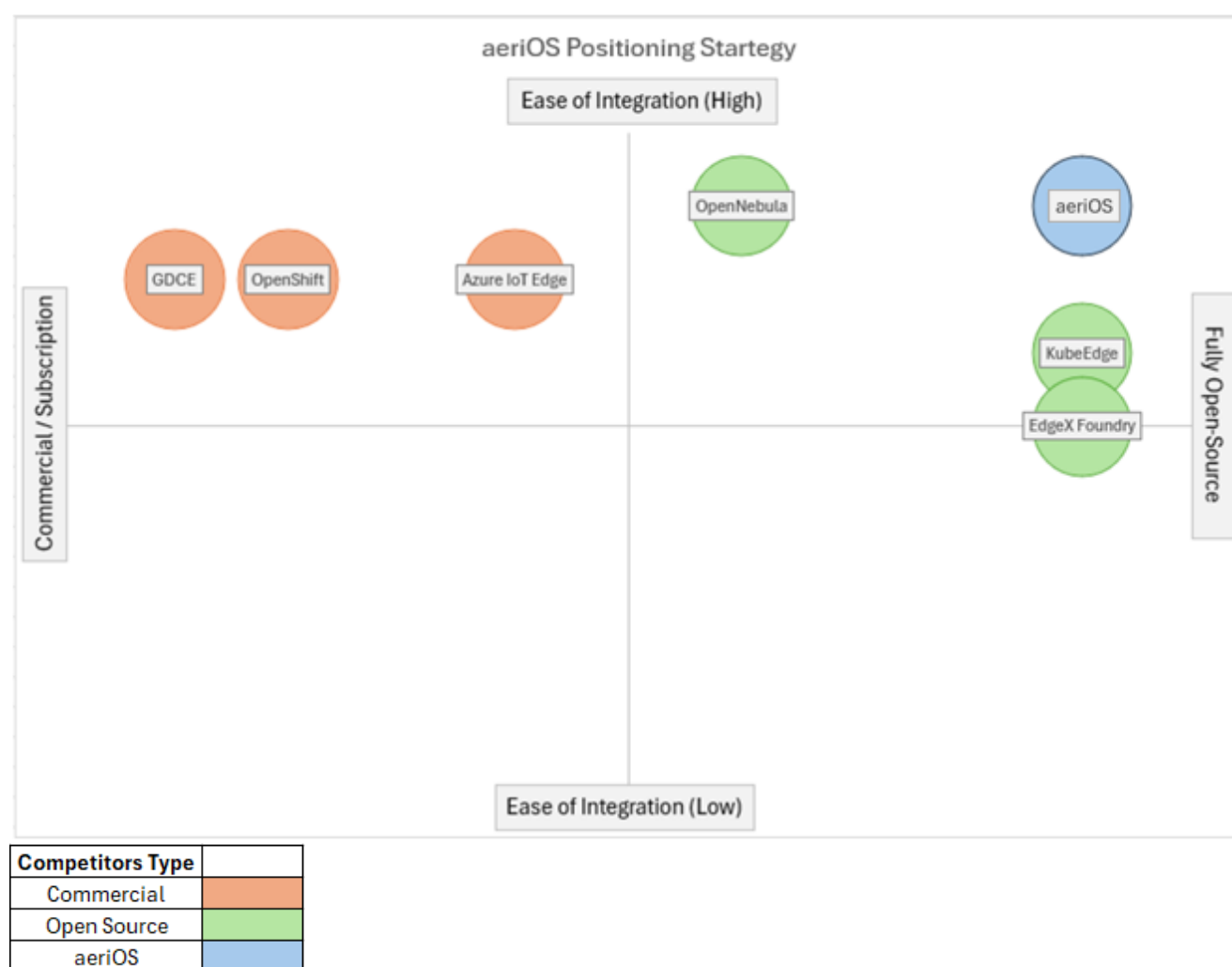


Figure 47 Perceptual Map Version 4

Axes Description

Commercial/Subscription → Fully Open Source: Show whether a platform is free and openly accessible or requires a paid subscription or enterprise license.

Ease of Integration: Evaluates how simple it is to integrate the platform in existing environments, based on standards, tooling, documentation.

Table 29 Positioning Justification

Platform	Commercial/Subscription Fully Open Source	Ease of Integration
aeriOS	aeriOS is open-source. All core components are available under Apache 2.0 licensing without any commercial barriers or vendor restrictions.	aeriOS relies on using de-facto standard communication technologies, such as HTTP REST APIs, OpenAPI documentation, solid data formats such as NGSI-LD and provides a series of components that are installed over a baseline infrastructure to be provided by the adopter (typically Kubernetes clusters, virtual machines, native systems or physical machines).

OpenNebula [32]	OpenNebula [32] is free and open-source software, released under the Apache License version 2, providing full-featured cloud management capabilities to the community. However, the binary packages of the Enterprise Edition with the production-ready version of OpenNebula [32] and the Enterprise Tools are distributed under a commercial license governed by the OpenNebula [32] Subscription Agreement. So OpenNebula [32] is partially open source, where enterprise-grade features and maintenance updates require paid subscriptions for production deployments.	OpenNebula [32] emphasizes integration through standardization, interoperability and portability, providing cloud users and administrators with a choice of several cloud interfaces (Amazon EC2 Query, OGF Open Cloud Computing Interface and vCloud) and hypervisors (VMware vCenter, KVM, LXD/LXC and AWS Firecracker). The Development Guide provides details about APIs to integrate cloud with third party applications, about the development of new infrastructure drivers to interface any specific storage, virtualization, monitoring or authorization system.
KubeEdge [33]	KubeEdge [33] is an open source system for extending native containerized application orchestration capabilities to hosts at Edge. It is licensed under Apache 2.0. and free for personal or commercial use.	KubeEdge [33] manages edge applications and edge devices in the cloud with fully compatible Kubernetes APIs and users can orchestrate apps, manage devices and monitor app and device status on Edge nodes just like a traditional Kubernetes cluster in the Cloud. KubeEdge [33] also supports MQTT and allows developers to author custom logic with standard protocols, making it adaptable to existing infrastructure.
Red Hat OpenShift (Edge) [34]	Red Hat OpenShift delivers open source innovation in a single, centralized platform and is an enterprise grade open source application platform built on the upstream open source project OKD, which is available under the Apache License (Version 2.0). However, Red Hat OpenShift is a paid, supported product available via a subscription model offering no-cost access to products such as Red Hat Enterprise Linux (RHEL), Red Hat OpenShift only through individual developer subscriptions for non-production use.	Red Hat OpenShift uses familiar tools and frameworks to create and deploy applications for any workload. It is designed to provide everything an organization may need to orchestrate containers, including enhanced security options and full-time professional support. Red Hat provides step-by-step guidance through comprehensive documentation and fully certifies and supports Kubernetes, Red Hat Enterprise Linux and the integrated container runtime as a unified platform.
Google Distributed Cloud Edge (GDCE) [36]	Google Distributed Cloud Edge (GDCE) [36] is a commercial enterprise platform. The platform features an open Kubernetes-based offering tuned for telecom network workloads, but the overall solution requires paid subscription and enterprise licensing.	Deploying workloads on a connected Distributed Cloud installation functions in a similar way to deploying workloads on cloud-based GKE clusters as your cluster administrator provisions Distributed Cloud connected clusters by using the Google Cloud console or the Google Cloud CLI. The platform provides comprehensive documentation with quickstarts, guides, key references, and assistance for addressing frequent issues and integration is achieved with a relatively low level of development effort, though it requires existing Google Cloud expertise for optimal integration.

Azure IoT Edge [35]	Azure IoT Edge [35] splits its architecture between an open-source edge runtime and a commercial cloud service dependency for production deployments. The IoT Edge runtime is open source and free under the MIT license, while the cloud management interface requires Azure IoT Hub, where Azure IoT Edge [35] is available in the free and standard tier of IoT Hub. The free tier is for testing and evaluation only.	Azure IoT Edge [35] supports both Linux and Windows so you can code to the platform of your choice. It supports Java, .NET Core 3.1, Node.js, C, and Python. The platform enables integration through packaging your business logic into standard containers with Docker-compatible modules, though production deployment requires Azure IoT Hub infrastructure and cloud connectivity.
EdgeX Foundry	EdgeX Foundry is a vendor-neutral open-source project hosted by The Linux Foundation and operates under the Apache 2.0 license that allows users to use the software for any purpose.	EdgeX Foundry builds a common open framework for IoT edge computing with an interoperability framework hosted within a full hardware- and OS-agnostic reference software platform to enable an ecosystem of plug-and-play components. The platform provides reference implementations for key IoT edge protocols (e.g. MQTT, Modbus, BACnet, etc.) along with SDKs and simplifies the integration of new and legacy devices/applications. It is highly modular and flexible, but the complexity of the systems requires heterogeneous coding and architectural expertise.

6.8. Business Model and Exploitation Strategy

The aeriOS business model is designed to balance open innovation, community collaboration, and commercial viability. It follows a hybrid open-source strategy, ensuring that the platform remains freely accessible as a public digital infrastructure while also enabling partners to develop sustainable business opportunities around it.

The approach aligns with the European Commission’s Open Source Software strategy [32] and Digital Sovereignty policies, which encourage transparency, shared development, and economic growth through open ecosystems. Under this model, the core Meta-OS framework remains openly governed and community-driven, while commercial exploitation is achieved through value-added layers, services, and ecosystem participation.

1. Open Core (Eclipse)

At the foundation of the exploitation strategy lies the Open Core model, which ensures that the essential aeriOS components—such as the core orchestrator, APIs, data models, and interoperability frameworks—are made freely available under the Apache 2.0 license (and one repo with MIT License) through the Eclipse Foundation.

This guarantees:

- **Open accessibility** for both public and private users, encouraging widespread adoption across sectors.
- **Transparency and trust** through Eclipse’s rigorous **IPR compliance** and governance processes.
- **Community-driven evolution**, where industrial and academic partners contribute to the continual improvement of the Meta-OS framework.

The Open Core approach establishes aeriOS as a reference implementation for the European computing continuum, enabling long-term sustainability through community stewardship rather than proprietary control. It ensures that the framework remains compatible with other open initiatives (e.g., Eclipse Kapua, Fog05, Zenoh) and can serve as the baseline layer for future European digital infrastructure projects.

2. Value-Added Extensions (Partners)

While the core of aeriOS remains open and freely available, commercial partners—including aerOS consortium members—are encouraged to build proprietary extensions and domain-specific modules on top of the open base.

These value-added components may include:

- Advanced analytics for AI-based workload optimization or predictive maintenance.
- Visualization dashboards for monitoring distributed sensors, or edge computing networks.
- Security and compliance modules, providing encryption, data integrity, or certification support for regulated industries
- Domain connectors tailored for specific markets (e.g., wind-energy analytics, atmospheric sensing, industrial automation).

This strategy creates a dual-layer ecosystem:

- The open layer, which ensures collaboration and interoperability.
- The commercial layer, which enables monetization, differentiation, and competitive advantage.

Through this model, partners can pursue commercial exploitation while continuing to benefit from the open, evolving technological foundation provided by Eclipse aeriOS.

3. Service-Based Monetization

The third pillar of the business model is based on services and expertise rather than proprietary software licensing. Given Eclipse's open governance principles, partners can generate revenue through integration, customization, and professional services built around the aeriOS framework.

This includes:

- **Integration Services:** Designing and deploying customized aeriOS installations for specific customer environments, such as smart infrastructures, or federated data systems.
- **Customization and Training:** Providing tailored modules, training sessions, and technical certification to help adopters effectively use and extend aeriOS.
- **Support and Maintenance:** Offering long-term technical support, feature updates, and managed hosting for enterprise users.
- **Consultancy and Certification:** Advising organizations on compliance, interoperability, and alignment with EU standards (e.g., AI Act, Data Act, Gaia-X, and EUCEI TF3 frameworks).



Figure 48 aeriOS Services

By providing such services, partners can establish sustainable revenue streams without undermining the open character of the platform. Furthermore, Eclipse hosting provides global visibility, industrial credibility, and access to a broad network of adopters—amplifying the commercial reach of participating organizations.

4. Licensing and IPR Governance

To protect partner contributions while preserving openness, aeriOS operates under a well-defined Intellectual Property Rights (IPR) and licensing framework that balances individual ownership and collective governance.

Key principles include:

- **Partner Ownership:** Each partner retains ownership of their proprietary contributions, whether hardware, software, or data models,
- **Common Code Contributions:** Shared contributions to the open core are governed by the Eclipse Contributor Agreement (ECA), ensuring legal clarity and full traceability. All accepted contributions are recorded in the Eclipse OSS Register, providing transparency in authorship and license compliance.
- **Dual-Licensing Possibility:** Certain modules may adopt a dual-licensing model—open for research and non-commercial use, with extended features available under commercial terms—enabling a gradual transition between open collaboration and market-oriented offerings.

This governance model not only safeguards innovation but also ensures that all contributions remain compliant with European open-source best practices, facilitating long-term reuse, interoperability, and collaboration with other Meta-OS initiatives.

Strategic Benefits of the Hybrid Model

The hybrid open-source business model delivers clear strategic benefits:

- **Sustainability:** Ensures continuous evolution of aeriOS beyond the lifespan of the aerOS project.
- **Economic Growth:** Enables partners to generate revenue through services and extensions without dependency on closed licenses.
- **Ecosystem Expansion:** Attracts external developers, startups, and industry actors, fostering a self-sustaining innovation community.
- **Digital Sovereignty:** Strengthens Europe’s ability to control its digital infrastructure and computing stack through open, verifiable technologies.

By combining openness with commercial scalability, the aeriOS exploitation strategy exemplifies “open innovation with sustainable impact”—a model that aligns with both Eclipse Foundation’s mission and Europe’s digital sovereignty vision.

6.9. Open Aspects and Ongoing Work

At the current stage, aeriOS remains under active development and community review. The following items are identified as open or pending actions:

- Finalization of Eclipse creation review and repository transfer (expected November 2025).
- Validation of third-party dependency compliance (Redpanda → NATS, Wireguard alternatives).
- Formal approval of Apache 2.0 licensing across repositories.
- Integration of documentation and developer guides following Eclipse OSS guidelines.
- Identification of external contributors and community engagement plan (SDOs, CSAs, EUCEI).
- Branding and visual assets update to reflect the new *aeriOS* identity.

Upon completion of these steps, Eclipse aeriOS will transition to the Incubation Phase, allowing public contribution and testing as part of the aerOS open ecosystem.

6.10. Summary

The Eclipse aeriOS business action marks a pivotal step in transforming the aerOS Meta-Operating System from a project-specific research framework into a sustainable, open, and community-driven European platform. By transferring its core assets to the Eclipse Foundation under the Apache 2.0 license, aerOS secures its long-term evolution within a trusted governance structure that promotes transparency, interoperability, and collective innovation.

Through this action, aeriOS establishes itself as a reference Meta-OS for the European computing continuum, seamlessly integrating IoT, edge, cloud, and space computing under a unified orchestration and trust framework. Its modular, standards-based design enables wide adoption across industrial, research, and public sectors while ensuring alignment with the EU Cloud-Edge-IoT (EUCEI) and Digital Sovereignty strategies.

The incubation and business development work carried out by UPV and the aerOS consortium—covering technical migration, licensing, branding, and ecosystem engagement—has laid the groundwork for aeriOS to enter full Eclipse incubation by late 2025. This milestone will open the project to external contributors, industrial adopters, and developers, ensuring long-term sustainability beyond the lifetime of the aerOS initiative.

The hybrid open-source business model adopted—combining an open core with value-added commercial services and extensions—provides a balanced pathway for partners to capitalize on aeriOS through integration, consultancy, and future tender participation.

Ultimately, Eclipse aeriOS embodies the aerOS vision of “*open innovation through open governance*”: it bridges research and market impact, strengthens Europe’s position in continuum computing, and sets the foundation for a new generation of sovereign, federated, and intelligent Meta-Operating Systems

7. Synergies and Business Analysis (Joint Exploitation Plans)

Building on the findings and opportunities outlined in Section 5, this part turns those insights into concrete actions through shared exploitation plans and pilot-focused business studies. Section 5 defined the foundations of intellectual property, innovation planning, and market positioning for aerOS. Here, those ideas are put into motion with practical plans for real-world application. Each pilot serves as a focused example within its own sector, showing how aerOS technologies and business approaches can be expanded, connected, and maintained beyond the project’s lifetime. Together, these studies shape the core of aerOS’s market approach and its aim to strengthen Europe’s digital independence and industrial strength over the long term.

7.1. Exploitation Plan for Pilot 1: Data-Driven Cognitive Production Lines

Pilot 1 of the aerOS project focuses on improving manufacturing through data-driven methods that support sustainability, precision, adaptability, and efficiency across four distinct scenarios. Each scenario serves as a separate case study with its own targets, challenges, and paths for application. The next section presents detailed exploitation plans for each scenario, followed by a unified plan that links their outcomes. This collective strategy draws on established business analysis tools, including SWOT, the Lean Model Canvas, Porter’s Five Forces, the Llava Matrix, and ROI evaluation.

7.1.1. Scenario 1: Green Manufacturing and CO₂ Footprint Monitoring (SIPBB)

Switzerland Innovation Park Biel/Bienne (SIPBB) leads Scenario 1 of the aerOS project, hosted within the Swiss Smart Factory (SSF) in Biel/Bienne. SIPBB is a private, non-profit organization dedicated to advancing sustainable, people-focused, and resilient production systems through applied research and development. This scenario targets key environmental issues by combining advanced technologies for live CO₂ tracking, the use of Digital Product Passports (DPPs), and the optimization of production and logistics operations. Its aim is to deliver a repeatable model for environmentally responsible manufacturing aligned with Industry 4.0 concepts.

The Swiss Smart Factory spans 1,000 m² and serves as a high-tech testing and demonstration space. It features a modern production line capable of batch-size-one manufacturing of quadcopters and hexacopters. Technologies such as Node-RED, which supports carbon footprint measurement, and the SMC Air Management System, which improves energy usage, are part of the setup. This facility functions both as a testbed and as a showcase for what aerOS-based solutions can achieve.

Vision and Objectives

Scenario 1 seeks to reshape how manufacturers approach sustainability. By using aerOS technologies, it focuses on three main targets:

1. **Real-Time CO₂ Tracking and Response** IoT and edge-cloud computing allow manufacturers to monitor emissions continuously and make adjustments immediately, maintaining full control over their environmental performance.
2. **Adoption of Digital Product Passports (DPPs)** These records increase transparency by displaying detailed information about a product's environmental footprint, helping both customers and partners make sustainable choices.
3. **Improving Production and Logistics** Streamlining manufacturing and supply processes reduces waste, conserves resources, and lowers carbon emissions.

Beyond these goals, SIPBB promotes knowledge sharing through training events, open demonstrations, and consulting, making sustainable production methods accessible to a wider community.

Challenges

Before aerOS was introduced, several limitations made sustainable manufacturing difficult. Centralized systems often ran continuously, even when production was idle, causing high energy use and excess emissions. Localized data networks restricted information sharing, and manual scheduling led to inefficiencies and resource loss. These problems raised operational costs and slowed progress toward greener practices, especially for small and medium-sized enterprises.

From its earlier assessments, SIPBB identified key areas that required change:

- **Energy Inefficiency:** Continuous system operation led to unnecessary energy use.
- **Lack of Transparency:** Conventional setups provided little insight into emission data.
- **Scheduling Problems:** Manual planning resulted in waste and production delays.

The aerOS framework addresses these gaps through decentralized, autonomous operations. With constant CO₂ tracking and advanced analytics, manufacturers can refine their workflows, respond to unexpected changes, and raise overall performance. This transformation turns the Swiss Smart Factory into a model of adaptable, low-impact manufacturing that can be replicated elsewhere.

Technological Advances

The aerOS implementation supports smooth data exchange using standardized protocols such as OPC-UA and REST-API, enabling interoperability between all assets. APIs connected to aerOS domains make real-time information accessible, forming the foundation of the DPP system. These passports compile detailed carbon footprint data for each product, offering insights that guide production and logistics improvements.

Key components integrated into the SIPBB Lighthouse Factory line include:

- **Node-RED:** Acts as the main platform for gathering and converting real-time data into NGSI-LD, ensuring compatibility with Orion-LD. It calculates CO₂ emissions using energy consumption data from each workstation.
- **SMC Air Management System:** Adjusts airflow according to equipment demand, cutting down on energy waste.
- **Embedded Analytics Tool (EAT):** Handles data collection, storage (Prometheus, PostgreSQL), and visualization (Grafana), along with CO₂ footprint calculations per asset and per order.
- **Predictive Analytics:** A moving average model estimates the footprint of future drone orders, offering practical insights for planning.
- **Digital Product Passport (DPP):** Records every stage of a product's life—from component sourcing and logistics to assembly and packaging. Each drone receives a QR code for full traceability and transparency.

Together, these components form a strong framework for sustainable, transparent manufacturing. By combining edge-level data acquisition (Raspberry Pi and Node-RED), orchestration and analytics through Kubernetes-based aerOS tools, and a full DPP system, the pilot demonstrates that carbon monitoring and optimization can be embedded directly into production.

The final configuration provides SIPBB and its partners with a fully functional example of sustainable, data-based manufacturing. It delivers tangible progress in interoperability, energy efficiency, and transparency, proving the practical value of the aerOS approach.

7.1.1.1. Exploitation Plan Before/After aerOS Implementation

The exploitation strategy for Scenario 1 is built to extend the benefits of aerOS technologies during the project and long after its completion. SIPBB takes advantage of its role as one of Switzerland's leading innovation hubs in Industry 4.0 to strengthen its service portfolio, form new collaborations, and widen its influence in sustainable manufacturing.

Prior to adopting aerOS, production at the Swiss Smart Factory depended on centralized control systems, which offered little transparency and consumed resources inefficiently. These drawbacks made it difficult for companies to meet environmental targets or lower their carbon footprint. With aerOS in place, production becomes distributed, data processing gains speed, and operational decisions can be made instantly based on live information.

Digital Product Passports (DPPs) bring an entirely new level of visibility to manufacturing. They let producers trace and document emissions throughout the supply chain, improving accountability and customer confidence. SIPBB plans to build on this innovation by launching specialized advisory and educational services that help businesses replicate such systems. Training sessions, open demonstrations, and guided visits at the Swiss Smart Factory will serve as main channels for spreading knowledge and encouraging wider adoption of the technologies among both small firms and larger manufacturers.

Comparison: Before and After aerOS

Before Implementation

- Operations were centrally managed and heavily dependent on local control with very limited live data access.
- Production lines ran continuously regardless of order flow, creating unnecessary emissions.
- Scheduling was manual and inefficient, wasting time and materials.
- **Technology Readiness Level:**
 - *Stage:* TRL 6
 - *Description:* Systems were validated in an operational test environment at the Swiss Smart Factory, with simulated orders and basic energy-efficiency goals.

- *Main Limits:* Low automation, minimal real-time data use, and few options for optimization or sustainability tracking.

After Implementation

- **Autonomous, Decentralized Production:** Lines operate only when needed, saving energy and reacting flexibly to disruptions.
- **Full Data Visibility:** APIs linked to aerOS domains enable uninterrupted information flow and continuous emission tracking across all stages of production.
- **Digital Product Passports:** Precise carbon-footprint data supports transparent reporting and responsible purchasing decisions.
- **Knowledge Expansion:** SIPBB provides workshops, consulting, and technical training, allowing partners to apply similar digital solutions.
- **Technology Readiness Level:**
 - *Stage:* TRL 8
 - *Description:* Technologies proven in daily factory operation with live CO₂ tracking, DPP generation, and adaptive production control.
 - *Benefits:* High automation, full data integration, and intelligent operational management suitable for roll-out to industrial settings across Europe.

Target Markets

SIPBB has identified several industries that stand to gain the most from aerOS integration. Manufacturing firms with multiple production sites can use real-time monitoring to cut emissions and optimize workflows. Logistics operators are another major group, since detailed emission data can support their sustainability objectives. Smart-city initiatives form a third target segment, as municipalities increasingly invest in technologies that lower energy use and environmental impact.

Because small and medium-sized enterprises often face financial and technical barriers to digitalization, aerOS is designed as a flexible, affordable platform they can adopt without large initial costs. SIPBB will reach potential users through direct contact, digital campaigns, and demonstration events.

Core Exploitation Actions

1. Service Development

- Introduce new consulting and training packages for SMEs to apply environmentally responsible manufacturing methods.
- Offer guidance on IoT-Edge-Cloud solutions built around aerOS technologies.

2. Knowledge Exchange

- Organize workshops, online sessions, and guided visits to present DPP deployment and aerOS applications.
- Arrange thematic events aimed at manufacturing, logistics, and urban sustainability sectors.

3. Revenue Generation

- Provide fee-based training and consulting, typically CHF 2 000 per two-hour session.
- Use the Swiss Smart Factory as a demonstration and pilot venue for businesses exploring Industry 4.0 solutions.

Indicators for Measuring Progress

Success will be evaluated through measurable outcomes such as:

- **Carbon Reduction:** Changes in CO₂ emissions per unit produced.
- **DPP Coverage:** Proportion of products linked to DPPs.
- **Operational Performance:** Efficiency improvements in scheduling and logistics.
- **Industry Engagement:** Number of adopters and feedback from participating organizations.

These indicators will help SIPBB confirm the long-term impact of aerOS. The Swiss Smart Factory expects to attract more than 3 000 visitors annually, hosting sessions on machine learning, data analytics, and IoT. The knowledge created through this scenario will continue to influence production practices well beyond the project's lifespan.

Market Outlook

SIPBB's outreach plan targets organizations most likely to gain from adopting aerOS:

1. **Manufacturing Enterprises:** Particularly those with distributed operations or high energy demands that seek measurable sustainability results.
2. **Transport and Logistics Firms:** Companies needing accurate, real-time emission data to optimize supply chains.
3. **Urban and Regional Programs:** Public projects focused on energy efficiency and low-carbon development.

To build awareness, SIPBB combines direct partner outreach with professional networking platforms and live demonstrations that showcase the system's advantages under real operating conditions.

Distinct Advantages

SIPBB stands out through two major strengths:

1. **Demonstration Infrastructure:** The Swiss Smart Factory offers a real production environment where partners can experiment with solutions before committing to full-scale use, lowering investment risk.
2. **Flexible System Design:** The modular structure of aerOS keeps implementation straightforward and affordable, which is particularly appealing for smaller firms.

Cooperation and Future Outlook

SIPBB relies on both internal expertise and external alliances to secure long-term success for Scenario 1.

Internal Capabilities

- Data scientists and IoT engineers refine aerOS components to improve precision and scalability.
- Environmental specialists ensure alignment with sustainability standards and assess real-world impact.

External Links

- Partnerships with technology suppliers guarantee compatibility and smooth integration across devices.
- Continuous dialogue with European regulators supports compliance with upcoming requirements for Digital Product Passports under the EU Ecodesign for Sustainable Products Regulation, contributing to circular-economy goals.

Continuing Activities After Project Completion

The experience gained in Scenario 1 will guide future initiatives:

1. **New Partnerships:** SIPBB plans formal collaborations with organizations such as the MADE Competence Center to promote aerOS and extend its use across Europe.
2. **Further Research and Innovation:** Follow-up work within projects like M4ESTRO and MODUL4R will expand aerOS functions in areas such as Manufacturing-as-a-Service, modular automation, and AI-driven supply-chain optimization.

Summary

Scenario 1 demonstrates SIPBB's long-term commitment to environmental responsibility through technological progress. Integrating aerOS into its production ecosystem has created a scalable and efficient approach to sustainable manufacturing. The exploitation plan guarantees that these advances extend beyond the Swiss Smart Factory, supporting cleaner and smarter production throughout Europe. Through openness, optimization, and continuous knowledge sharing, SIPBB is shaping the next generation of sustainable industry.

7.1.2. Scenario 2: Automotive Smart Factory Zero Defect Manufacturing (INNO)

The second pilot of the aerOS project is coordinated by the Innovalia Association (INNO) and focuses on achieving *Zero Defect Manufacturing* within the Automotive Smart Factory. The pilot takes place at the Automotive Intelligence Center (AIC) in Bilbao, where Innovalia applies its deep experience in advanced manufacturing and digital innovation. As a non-profit research organization, Innovalia develops and validates technologies in areas such as end-to-end cybersecurity, quality assurance for complex cyber-physical systems, 3D visualization for mobile platforms, and AI-based big data infrastructures.

This scenario tackles ongoing challenges in industrial metrology, particularly inefficient scheduling, rigid system architectures, and energy-intensive continuous operations. By integrating aerOS solutions, Innovalia aims to embed intelligence and automation into these processes, raising efficiency, sustainability, and adaptability across the entire production chain.

The technical foundation for this pilot, provided by Nasertic, includes high-performance systems such as Spark, Vulkan, Duplex gauges, CMM Control units, and the Robot Link platform. Additional software and hardware elements—Optiscan and M3 among them support advanced analysis and monitoring. The setup relies on OPC-UA for standardized data communication, virtual commissioning environments for 3D representation, and a dedicated CMM monitoring infrastructure that ensures accuracy and reliability.

As deployment advances, aerOS domains are being integrated into this ecosystem to connect all assets and enable more intelligent, flexible, and autonomous manufacturing operations.

Main Goals and Expected Outcomes

The overarching aim of Scenario 2 is to reach *Autonomous Metrology 4.0*. This concept redefines dimensional metrology through adaptive design, automation, and digital connectivity. By modernizing metrology workflows, Innovalia seeks to create sustainable, efficient, and low-error production processes that operate with minimal manual intervention.

Key outcomes include:

1. **Higher Process Efficiency:** Simplifying and accelerating metrology workflows to avoid unnecessary delays and reduce rework.
2. **Improved Measurement Precision:** Enhancing the accuracy of inspection processes to meet demanding automotive standards.
3. **Remote Operation Capabilities:** Allowing experts to monitor and manage systems from a distance using advanced visualization and control tools.
4. **Operational Robustness:** Developing systems capable of reacting dynamically to production changes or unexpected disruptions.
5. **Environmental Responsibility:** Lowering waste and energy use by optimizing inspection and production cycles.

7.1.2.1. Exploitation Plan – Before/After aerOS Implementation

Within the aerOS project, Innovalia has taken a leading role in tackling major bottlenecks in manufacturing metrology, specifically those limiting openness, scalability, and operational speed. The introduction of aerOS-based technologies in the Automotive Smart Factory's *Zero Defect Manufacturing* pilot represents a decisive

leap toward a new benchmark in quality control. This transition closes long-standing gaps such as fragmented data exchange, dependence on specialized operators, and reactive maintenance practices. By deploying real-time digital tools, remote control functions, and predictive maintenance, aerOS lays the groundwork for production systems that are accessible, adaptable, and environmentally conscious. The following exploitation plan describes the transformation achieved before and after aerOS adoption and highlights the opportunities it brings to the metrology field.

Before aerOS

Before aerOS integration, manufacturing metrology faced a series of structural and operational limits that curbed productivity and innovation:

- **Restricted Market Reach:** Existing systems were suited mainly for expert technicians, limiting accessibility for general users and smaller companies.
- **Limited Expansion Across Sites:** Complex setup procedures hindered multi-site deployment and scalability.
- **Slow Data Flow:** Outdated communication protocols and legacy security frameworks slowed data exchange and reduced cooperation between teams.
- **Lack of Digital Twin Capabilities:** Without live process simulation, predicting or preventing faults was nearly impossible.
- **Reactive Maintenance:** Systems were typically repaired only after failures occurred, resulting in costly downtime and inefficiency.
- **Technology Readiness Level (TRL):**
 - *Status:* TRL 9 — technologies proven and used in active industrial environments.
 - *Description:* Validated systems tested in Innovalia and partner facilities under real operating conditions.
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After aerOS

The adoption of aerOS marks a turning point, addressing these limitations through digitalization, automation, and integrated data management. In practice, aerOS creates an intelligent ecosystem—the *Metrology Continuum*—where machines, sensors, and software cooperate in real time.

Key results include:

- **Expanded Accessibility:** Simplified setup and user interfaces allow a wider range of professionals to use the tools, including non-experts and SMEs.
- **Improved Scalability:** Multi-site compatibility enables unified operations across different facilities and geographic regions.
- **Efficient Data Exchange:** Updated security standards and faster communication channels improve transparency and customer confidence.
- **Remote Functionality:** Operators can manage, monitor, and fine-tune systems from any location, reducing dependence on on-site specialists.
- **Digital Twin Integration:** Simulation and live monitoring capabilities allow predictive decision-making and process optimization.
- **Preventive Maintenance:** The system anticipates issues before they disrupt operations, reducing downtime and human intervention.
- **Technology Readiness Level (TRL):**
 - *Status:* Prototype solutions at TRL 8, tested in real industrial settings.
 - *Description:* Enhanced configurations installed in partner sites and customer facilities.

- *Benefits:* Significant gains in performance, reliability, and usability compared with legacy systems.

Core Technological Contributions of aerOS

The aerOS platform introduces several innovations that directly improve how metrology systems operate:

- **Distributed Computing:** Tasks are processed at the IoT-edge level, reducing latency and optimizing resource use. Computation occurs close to the source of data, improving responsiveness and enabling true real-time operations.
- **Continuum Management:** This feature simplifies hardware and software integration, making system setup intuitive even for non-specialists. It accelerates deployment and broadens user participation, supporting greater scalability.
- **Advanced Protection Mechanisms:** aerOS integrates strong security protocols for both human-machine and machine-machine communication, safeguarding data integrity and operational reliability in highly connected industrial networks.

Together, these advances create a secure, efficient, and user-oriented foundation for modern metrology.

Addressing Industry Needs

Innovalia's exploitation roadmap for Scenario 2 is designed around market gaps in accessibility, digital flexibility, and remote capability. The metrology sector serves high-precision domains—automotive, aerospace, and medical devices, where reliability and accuracy are vital. Yet, these industries increasingly need modular, easy-to-integrate, and cloud-based tools. Innovalia's objective is to meet that demand with flexible quality-control services supported by aerOS.

Value Proposition

Innovalia's strength lies in providing a complete metrology ecosystem that combines high-end hardware, dedicated software, and cloud-based infrastructure. This combination reduces configuration time, enhances accuracy, and enables real-time supervision and control from remote locations. Faster setup directly lowers costs by reducing the need for an on-site expert. The platform's self-correcting capabilities also allow specialists to focus on prevention and optimization rather than reactive maintenance.

Indicators of Success

The effectiveness of the Automotive Smart Factory pilot will be tracked through measurable improvements in several performance dimensions:

- **Measurement Precision:** Evaluates progress in achieving tighter tolerances and consistent quality outcomes.
- **Error Reduction:** Tracks decreases in deviations, rework, and waste across measurement and inspection workflows.
- **Process Speed:** Measures reductions in setup and inspection times, reflecting the system's efficiency gains.
- **Customer Uptake:** Observes adoption rates and user feedback to gauge usability and relevance to industry needs.
- **Market Positioning:** Benchmarks Innovalia's competitive standing relative to other metrology solution providers, emphasizing accuracy, flexibility, and user reach.

These indicators collectively define how aerOS improves both technical performance and market competitiveness.

Economic and Strategic Impact

Innovalia will assess implementation costs and potential revenue streams to build a scalable model adaptable to diverse customer groups, from large corporations to SMEs. Intellectual property protection will be central to safeguarding aerOS-based innovations and maintaining Innovalia's competitive advantage.

Transformative Impact of aerOS

Before the deployment of aerOS, Innovalia's solutions were limited by expert dependency, slow communication, and isolated system design. With aerOS, these barriers are removed:

- Systems become easier to deploy and use.
- Data moves faster and more securely between sites.
- Quality assurance becomes a proactive, continuous process rather than a reactive one.

The outcome is a more agile and intelligent metrology environment that supports end-to-end manufacturing optimization.

Market Outlook and Opportunities

Demand for aerOS-driven solutions is growing among industries that depend on strict quality control and process reliability. The technology is positioned to benefit sectors including:

1. **Precision Manufacturing:** Automotive and aerospace producers that require fault-free processes and exact dimensional accuracy.
2. **High-Technology Industries:** Sectors such as renewable energy, rail, and medical equipment manufacturing, where continuous monitoring and traceability are key.

Market Engagement

To promote adoption, Innovalia will use several outreach methods:

- Participation in industrial exhibitions and conferences to demonstrate aerOS applications through live showcases.
- Publication of articles, technical reports, and case studies that present measurable outcomes and best practices.
- Collaboration with current clients to document shared successes and foster credibility in new markets.
-

Competitive Strength

Innovalia's edge lies in merging precision metrology, digital automation, and data security within a single cohesive framework.

Key Differentiators:

1. Integrated end-to-end metrology environment connecting hardware, software, and cloud analytics.
2. Scalable and modular setup adaptable to different production contexts.
3. Proven cybersecurity and data protection mechanisms.
4. Ease of use and remote accessibility that opens advanced metrology to smaller enterprises.

Future Synergies and Development Paths

Innovalia plans to expand the reach and interoperability of aerOS through collaboration and research.

Planned Actions:

1. Partnership with the Eclipse Foundation to develop open-source components, boosting visibility and community-driven improvements.
2. Application of aerOS-enabled metrology across other industries, such as aerospace and medical manufacturing.
3. New partnerships with organizations including MADE and POLIMI to share knowledge and extend joint exploitation.
4. Continued research into AI-supported calibration, autonomous inspection, and multi-domain digital twins.

Summary

The Automotive Smart Factory pilot illustrates Innovalia's commitment to transforming metrology through digital innovation. By embedding aerOS into its processes, the organization delivers measurable gains in precision, agility, and environmental performance. The exploitation strategy ensures that these improvements continue beyond the project's lifecycle, reinforcing Innovalia's leadership in the field of industrial metrology. Through efficiency, accuracy, connectivity, and sustainability, the pilot establishes a model for future manufacturing quality systems across Europe and beyond.

7.1.3. Scenario 3: Flexible Lot-Size-1 Production Systems (Siemens)

The third pilot within the aerOS project, coordinated by **Siemens**, explores the concept of *Zero Ramp-Up* through safe, dynamic PLC reconfiguration in **lot-size-one production**. This work is carried out in the **TechHall** facility in Nuremberg, Siemens' state-of-the-art technological laboratory dedicated to next-generation manufacturing.

As one of the global leaders in industrial automation, infrastructure, and digital innovation, Siemens contributes its extensive expertise to develop flexible, modular, and intelligent production systems capable of adapting to constantly changing manufacturing conditions.

The focus of this scenario is the creation of a **cyber-physical production environment** that connects automated guided vehicles (AGVs), robotic arms, and distributed computational nodes through aerOS-based intelligence and communication layers. The approach integrates Siemens' **SIMATIC Industrial Edge** platform with cloud services to enhance overall production efficiency, adaptability, and scalability.

Infrastructure support for this pilot is provided by **Nasertic**, maintaining alignment with the technological setup used in the Pilot 1 group. Siemens deploys advanced hardware and digital tools to bring this scenario to life, including:

- Four AGVs equipped with dedicated charging stations.
- Two robotic arms for automated assembly and handling.
- Three Raspberry Pi units serving as decentralized computing nodes.
- Industrial PCs (IPCs) acting as Edge devices within the aerOS framework.

The entire system communicates through a combination of industrial standards such as **PROFINET**, **OPC-UA**, **ROS2**, and **MQTT**, ensuring smooth data exchange and interoperability across devices and systems.

The central goal of Scenario 3 is to demonstrate how highly adaptable production facilities can thrive in increasingly connected and customized manufacturing settings. By combining Siemens' industrial ecosystem with aerOS capabilities, the pilot showcases how factories can respond to shifting production requirements in real time and achieve faster, safer transitions between production states.

Expected Outcomes and Advantages

1. **Greater Agility:** Shifting from rigid, predefined setups toward modular systems that adapt dynamically to changing demands.
2. **Integrated Communication:** Closing the gap between operational technology (OT) and information technology (IT) to enable unified data flow and coordination.
3. **Improved Throughput:** Using automation, decentralized control, and AI-driven orchestration to streamline production processes.
4. **Personalized Manufacturing:** Supporting *lot-size-one* production models that meet the growing need for individualized products without compromising efficiency.
5. **Interoperable Systems:** Establishing unified solutions that harmonize different machine protocols to support true standardization across production environments.

7.1.3.1. Exploitation Plan – Before/After aerOS Implementation

Modern manufacturing is moving rapidly toward shorter product cycles and increasing levels of customization. Conventional fixed production systems struggle to keep up with these shifts, often lacking the agility and connectivity needed to react in real time. The introduction of **aerOS** technology marks a fundamental change, linking operational and information layers into a unified environment that supports automation, interoperability, and standardized communication. This evolution allows factories to become more adaptive and responsive to changing market requirements.

The transformation highlights aerOS as a cornerstone for flexible manufacturing, made possible through instant data exchange, coordinated orchestration, and seamless integration among diverse machines and digital systems. The following plan outlines how Siemens' pilot has reshaped production operations before and after aerOS implementation, demonstrating how long-standing limitations are turned into pathways for innovation.

Before aerOS

Before the arrival of aerOS, production facilities followed rigid configurations that were difficult to adapt to dynamic or personalized orders. These setups relied on manual reprogramming, lacked interoperability, and operated with long ramp-up times whenever a product variant changed.

Key Limitations

- **Inflexible Setups:** Traditional systems could not reconfigure quickly enough for fluctuating demand.
- **Fragmented OT-IT Integration:** Weak communication between shop-floor control and enterprise systems caused data silos and inefficiencies.
- **Vendor-Specific Solutions:** Each machine builder provided its own protocols, preventing large-scale standardization or reuse.

Technology Readiness Level (TRL)

- **Status:** TRL 1 for the new “zero-ramp-up” capability. The individual assets (robots, AGVs, PLCs, and safety modules) were already at TRL 8–9.
- **Description:**
 - Flexible-manufacturing concepts existed mainly as research prototypes.
 - Any reconfiguration demanded on-site experts to rewrite PLC code, manually fine-tune processes, and supervise extended test runs.
- **Observed Challenges:**
 - No shared skill or data model; each vendor used proprietary logic.
 - Orchestration was embedded in individual PLCs, making updates slow and prone to errors.
 - Product changes could halt production for hours or even days.
 - Cyber-security and traceability were isolated from core operations.

After aerOS

With aerOS in place, Siemens replaces static architectures with automated, self-orchestrated systems that can reconfigure safely and efficiently. The aerOS orchestrator distributes tasks among devices in real time, requiring minimal manual input.

Main Outcomes

- **Automated Coordination:** Task scheduling across AGVs, robots, and PLCs adjusts dynamically without stopping production.

- **Unified OT-IT Layer:** Continuous communication links the factory floor with higher-level applications, improving collaboration and throughput.
- **Protocol Harmonization:** Integration of PROFINET, OPC-UA, ROS 2, and MQTT delivers full interoperability within one production environment.

Detailed Innovations

- **Data Interoperability:** aerOS merges several industrial standards, enabling friction-free data flow between heterogeneous machines.
- **AI-Supported Orchestration:** Intelligent algorithms balance workloads, assign tasks, and predict optimal machine usage.
- **Secure Connectivity:** API gateways and tunneling protect information exchanges and maintain system integrity.

Technology Readiness Level (TRL)

- **Status:** TRL 3 – Experimental proof-of-concept for the adaptability layer.
- **Description:**
 - The orchestrator runs on Siemens Industrial devices controlling four AGVs and two robotic arms in the TechHall.
 - Plug-and-produce connectors and automatically generated low-code modules reduce engineering effort.
 - Skill-based scheduling, device discovery, and secure communication are validated on an active production floor without halting operations.
- **Benefits:**
 - Ramp-up time reduced from several hours to minutes.
 - Engineering documentation generated automatically for improved traceability.
 - Non-specialists can configure new product variants through an intuitive graphical interface.
- **Next Steps toward TRL 5–9:**
 - Expand the ontology and skill framework to map machine abilities automatically and achieve full plug-and-produce compatibility.
 - Develop integrated life-cycle and sustainability models that connect legacy and new assets for eco-efficient production planning.

Overall Impact

The aerOS deployment transforms Siemens' operational model. Where earlier systems depended on expert programmers, site-specific setups, and delayed data sharing, the new environment introduces autonomous orchestration, secure networking, and proactive maintenance.

Key Gains

- Wider accessibility through simplified configuration and user interfaces.
- Easy scaling to multiple plants with consistent workflows.
- Real-time monitoring and digital-twin visualization for predictive decision-making.
- Reduced downtime through automated fault detection and preventive maintenance.

Meeting Market Demands

Manufacturing today moves toward mass customization and near-continuous product updates. Siemens' strategy under Scenario 3 directly responds to this trend by uniting automation, digitalization, and standardization. The integration of OT and IT—once separate domains—now provides the flexibility, interoperability, and visibility required for efficient lot-size-one production.

Siemens' Value Proposition

Scenario 3 showcases Siemens' ability to deliver compact, modular, and highly versatile production systems.

- **Unified Platform:** Standardized communication across diverse protocols simplifies deployment and scalability.
- **Reduced External Dependence:** A self-contained solution minimizes the need for third-party integration services.
- **AI-Driven Efficiency:** Intelligent orchestration maximizes resource use and minimizes manual adjustments.
- **Adaptability and Resource Economy:** Modular design ensures efficient use of space, energy, and hardware.

This approach gives Siemens a unique advantage in supporting factories aiming for personalized production at industrial scale.

Measuring Success

Progress will be tracked through several indicators:

1. **System Reliability:** Ability to maintain stable operation under varied conditions.
2. **Production Agility:** Responsiveness of the system to changing orders or configurations.
3. **Integration Quality:** Level of seamless data flow between OT and IT environments.
4. **Scalability:** Ease of replication across multiple plants and production volumes.
5. **Customer Uptake:** Adoption rates and satisfaction among early industrial users.

Exploitation Pathways

Siemens intends to build on Scenario 3 outcomes through a combination of learning, dissemination, and commercialization.

- **Innovation Transfer:** Applying pilot lessons to future R&D projects focused on adaptive manufacturing.
- **Internal Knowledge Sharing:** Integrating results into Siemens' wider product and engineering portfolio.
- **Customer Engagement:** Organizing workshops and demonstration events to present tangible benefits.

Long-Term Outlook

- **Product Development:** New Siemens products will integrate AI-based orchestration, improved OT/IT connectivity, and modular architectures.
- **Research Expansion:** Continued studies into AI-driven scheduling, predictive analytics, and advanced cyber-physical systems.
- **Strategic Investment:** Directing resources toward scalable technologies that improve flexibility and interoperability.

- **Market Growth:** Leveraging validated pilot results to enter additional industries such as aerospace, consumer goods, and renewable-energy manufacturing.

Market Outlook and Engagement

Industries that depend on precision, reliability, and adaptive production represent the main opportunity areas for aerOS.

Primary Segments

1. **Precision Manufacturing:** Automotive and aerospace sectors seeking exact tolerances and high productivity.
2. **High-Technology Domains:** Renewable energy, rail, and related sectors requiring robust quality assurance and system resilience.

Engagement Strategy

- Active presence at industry exhibitions to demonstrate working prototypes.
- Publication of technical papers, case studies, and user stories to build credibility.
- Collaboration with early customers to share best practices and results.

Competitive Strength

Siemens distinguishes itself through its integrated approach, merging hardware, software, and secure cloud infrastructure into one coherent ecosystem.

Distinct Advantages

- End-to-end automation environment connecting every level of production.
- Scalable, modular architecture suitable for enterprises of any size.
- Strong cybersecurity foundation protecting both data and operations.
- Simplified deployment that extends advanced manufacturing capabilities to a wider range of users.

Collaboration and Future Development

Success in Scenario 3 relies on both internal excellence and strategic alliances.

- **Internal Expertise:** Data scientists, IoT engineers, and sustainability teams continue refining aerOS components.
- **External Partnerships:** Cooperation with equipment suppliers ensures compatibility, while dialogue with regulatory bodies supports standardization initiatives and compliance alignment.

Future Initiatives

1. Expand partnerships with competence centers such as MADE to promote knowledge exchange and technology transfer.
2. Participate in new research projects at regional and EU levels to enhance aerOS scalability and intelligence.

Summary

The *Zero Ramp-Up Safe PLC Reconfiguration for Lot-Size-One Production* pilot demonstrates Siemens' forward-looking approach to digital manufacturing. By integrating aerOS with its own industrial ecosystem, Siemens delivers flexible, secure, and high-performance solutions suited to modern production challenges. The exploitation strategy ensures that these results shape future Siemens products, reinforce its leadership in industrial automation, and set a benchmark for agile, data-driven manufacturing across Europe and beyond.

7.1.4. Scenario 4. AGV Zero-Breakdown Logistics (MADE-POLIMI)

The fourth pilot of the aerOS initiative is jointly managed by the **MADE Competence Center** and the **POLIMI Industry 4.0 Laboratory**. Activities unfold between two interconnected sites: MADE's 2,500 m² pilot plant and POLIMI's advanced research facility in Milan. The purpose of this use case is to deploy an **IoT Edge-Cloud Meta-Operating System** that can seamlessly balance computational workloads between local and remote layers while maintaining secure, continuous data circulation across the network.

This demonstration unites several Industry 4.0 technologies to emulate the production of customized mechanical valves for the oil-and-gas sector. The simulated line mirrors an entire manufacturing chain divided into three tightly linked phases:

1. **Mechanical Processing** – Produces valve components with variable geometries tailored to end-user specifications.
2. **Manual Assembly** – Combines mechanical parts under human supervision to verify accuracy and ensure compliance with quality targets.
3. **Automated Assembly & Testing** – Finalizes construction and performs functional inspections using automated instrumentation.

Infrastructure and Equipment

- **Robotic and Mechatronic Modules:** High-precision manipulators and motion systems deliver consistent throughput and repeatability across the process.
- **Integrated Intralogistics Line:** A coordinated transport network links every station, keeping materials in motion and eliminating idle phases.
- **Automated Guided Vehicles (AGVs):** Mobile carriers equipped with advanced control logic optimize internal logistics, shortening lead times and increasing production agility.

One of the most distinctive elements of this scenario is the **real-time operational bridge** between MADE's demonstrator and POLIMI's laboratory. When the aerOS controller identifies saturation on the primary line, it automatically activates a secondary workflow at the remote site. This cross-facility orchestration showcases the system's ability to redistribute resources instantly, sustaining output without interruptions and balancing workloads dynamically.

Pilot Goals and Expected Impact

The project explores how distributed intelligence can reshape modern production by embedding autonomy and adaptability into everyday factory operations. The main ambitions include:

1. **Decentralized Processing:** Executing data analysis directly on edge nodes to lessen cloud dependence, improve responsiveness, and enhance local decision-making.
2. **Collaborative Intelligence:** Applying machine-learning models that coordinate actions between the two facilities, ensuring efficient energy and equipment utilization.
3. **Open Data Frameworks:** Employing interoperable standards and modular APIs to integrate external devices and software with minimal configuration effort.
4. **Advanced AGV Optimization:** Using routing algorithms to refine travel paths, reduce energy consumption, and guarantee continuous material flow.

Together, these features form a blueprint for factories capable of self-adjusting operations in real time, maintaining productivity even under changing demand conditions.

Role of the Partners

The **MADE Competence Center** serves as the operational backbone of this pilot. As a public-private hub supporting Lombardy's industrial base, MADE accelerates the introduction of digital tools and methodologies to manufacturers of all sizes.

- **Technology Transfer:** Gives SMEs practical access to Industry 4.0 applications and hands-on demonstrations, bridging research outcomes with everyday use.
- **Collaborative Network:** Connects technology suppliers, system integrators, and universities, encouraging joint experimentation and collective learning.
- **Human-Capital Development:** Provides targeted programs to build the digital and technical skills needed for next-generation factory environments.

The **POLIMI Industry 4.0 Lab** complements this industrial perspective with academic rigor and scientific methodology. Its contribution guarantees that the strategies validated through aerOS are not only technically sound but also scalable across diverse manufacturing settings. By pairing theoretical research with pilot-scale validation, POLIMI transforms conceptual advances into concrete, repeatable industrial practices.

Through the partnership between MADE and POLIMI, this scenario exemplifies how coordinated action between research and industry can accelerate Europe's transition toward intelligent manufacturing. The results establish a transferable framework for connected production systems that balance performance, resilience, and sustainability.

The distributed architecture tested here demonstrates that manufacturing can evolve beyond centralized models toward agile, cooperative ecosystems. Once proven, the aerOS-based approach will serve as a model for future European factories seeking to integrate edge-cloud technologies for higher responsiveness, energy efficiency, and operational continuity.

7.1.4.1. Exploitation Plan – Before/After aerOS Implementation

Before aerOS entered the picture, industrial production sites operated within a tangled mesh of incompatible technologies. Equipment from different vendors created isolated computing islands, each running its own protocols and architectures. This fragmentation made it difficult to coordinate resources or develop distributed applications that could run seamlessly across facilities. Centralized processing remained the default model, adding latency, driving up energy and operational costs, and exposing systems to higher cybersecurity risks.

Before aerOS

Key Limitations

- **Fragmented Infrastructure:** Multiple, vendor-specific subsystems complicated integration and blocked a unified computing model.
- **Lack of Distributed Capability:** Cloud–Edge–IoT systems functioned independently, preventing synchronized operation across sites.
- **Overreliance on Central Servers:** Centralized decision-making increased dependency, limited autonomy, and slowed real-time responsiveness.

Technology Readiness Level (TRL):

- **Status:** TRL 4–5
- **Description:** Existing setups were early prototypes that demonstrated technical feasibility but lacked maturity for large-scale industrial deployment.

After aerOS

The deployment of **aerOS** replaced these fragmented systems with a harmonized digital backbone. The platform introduces standardized APIs and easy-to-use configuration interfaces that allow even non-specialist technicians to program and manage production environments. By bringing interoperability to previously disconnected devices, aerOS merges diverse assets into a cohesive operational network. Its distributed resource management dynamically allocates computing tasks along the Cloud–Edge–IoT continuum, ensuring higher efficiency and shorter response times. The result is a step toward **autonomic and swarm-oriented industrial computing**, where production systems can coordinate and adapt on their own.

Key Results

- **Simplified Configuration:** Unified APIs and templates cut down engineering time and simplify deployment.
- **Interoperable Systems:** Real-world industrial lines combining machines from multiple suppliers now operate within a shared framework.
- **Distributed Resource Management:** aerOS automatically balances workloads across connected nodes to reduce idle time.
- **Swarm Intelligence Foundations:** The platform paves the way for cooperative computing between factories and devices.

Technology Readiness Level (TRL):

- **Status:** TRL 7
- **Description:** Pre-industrial validation completed successfully, proving technical readiness for pilot-scale manufacturing.

Core Technological Advances

aerOS introduces a new digital architecture that turns fragmented production environments into dynamic, cooperative systems.

1. **Edge-Oriented Computation:** Shifting data processing closer to machines enables real-time analytics and minimizes dependence on distant cloud resources.
2. **Lightweight AI and ML Orchestration:** Compact machine-learning models coordinate actions across distributed facilities, balancing loads and optimizing performance.
3. **Unified Data Standards:** Common data models allow devices and software from different vendors to share information seamlessly.
4. **Accessible APIs:** Configuration and control no longer require deep coding knowledge, accelerating adoption and scalability.

Collectively, these features redefine how production lines are deployed, managed, and evolved—making automation more accessible, secure, and efficient.

Market

Manufacturers are under growing pressure to deliver faster, more customized products while maintaining quality and reducing energy use. Fragmented digital infrastructures remain a major obstacle. aerOS directly responds to these industry realities.

By uniting different systems under a shared communication layer, it removes one of the most persistent barriers in industrial digitalization: lack of interoperability. Shifting computation from centralized servers to distributed edge nodes allows decisions to be made instantly and securely, cutting latency and cloud costs. Finally, the platform's open, modular architecture makes it easy for engineers and operators to adjust configurations without specialized expertise.

The result is an ecosystem where machines, plants, and operators function as a connected whole—responsive, scalable, and ready for continuous production changes.

Value Proposition

aerOS offers manufacturers a decisive advantage: the ability to turn standalone plants into an integrated, intelligent production network. It allows factories to share computational power and workloads dynamically, ensuring that production continues even when one site approaches capacity.

By combining distributed computing with AI-based coordination and standardized data exchange, aerOS increases uptime, accelerates configuration, and simplifies orchestration. Its human-friendly interfaces lower technical barriers and shorten the path from prototype to operation.

This isn't just a software improvement—it's a redefinition of industrial structure. With aerOS, manufacturers gain agility, data sovereignty, and resilience in the face of fluctuating demand. It lays the digital foundation for the next phase of Industry 4.0: autonomous, interconnected, and sustainable production.

Target Market

The collaboration between **MADE Competence Center** and **POLIMI Industry 4.0 Lab** forms a powerful innovation ecosystem for testing and knowledge transfer. MADE connects directly with **SMEs** through its regional and European innovation networks, offering real-world environments for experimentation. POLIMI brings the academic expertise needed to translate research results into scalable industrial practices.

Main Customer Groups

- Manufacturing firms seeking to unify operations across multiple sites.
- System integrators providing Industry 4.0 solutions to diverse industrial clients.

Engagement Actions

- Interactive demonstrations and guided tours at MADE and POLIMI facilities.
- Training workshops and webinars tailored for SMEs and integrators.
- Collaboration with EDIH networks to broaden outreach and adoption.

Through hands-on testing, companies can evaluate aerOS capabilities directly, bridging the gap between innovation and implementation.

Indicators of Success

The impact of this pilot will be assessed using practical and measurable indicators:

1. **Reliability:** Stable operation across various manufacturing configurations.
2. **Optimization Performance:** Quantifiable improvement in AGV routing and resource utilization.
3. **Integration Scalability:** Verified compatibility between multi-vendor systems in operational environments.
4. **User Engagement:** Growth in participation and positive feedback from SMEs and integrators involved in the pilot phase.

These indicators provide a comprehensive picture of the solution's maturity and market readiness.

Next Steps and Long-Term Outlook

The completion of this pilot positions aerOS for expansion across Europe's manufacturing landscape. The next phase will focus on translating technical success into industrial-scale solutions.

Strategic Objectives:

- **Stronger Partnerships:** Deepen collaboration within European Edge-Cloud-IoT communities to boost innovation and standardization.
- **Institutional Anchoring:** Reinforce MADE's and POLIMI's leadership roles in technology transfer and industrial education.
- **Commercial Evolution:** Develop market-ready products that embed AI-driven orchestration, modular design, and improved OT-IT alignment.

- **R&D Expansion:** Pursue advanced studies in decentralized control, predictive analytics, and cross-site optimization.
- **Investment Focus:** Channel resources toward technologies with the highest potential for broad industrial application.
- **Sector Diversification:** Extend aerOS solutions to high-value industries such as automotive, aerospace, renewable energy, and precision manufacturing.

Through these measures, aerOS will evolve from a research framework into a cornerstone technology for Europe's smart manufacturing transformation.

Conclusion

The connected factories pilot demonstrates how aerOS breaks down technological silos and builds resilient, intelligent manufacturing ecosystems. Its edge–cloud coordination, distributed intelligence, and interoperability transform production networks into living, adaptive systems. By merging flexibility with security and efficiency, aerOS defines a new operational standard—one that enables factories to act collectively, think locally, and scale globally.

7.1.5. Joint Exploitation Plan: Integrating Scenarios for Maximum Impact

TPilot 1 of the **aerOS project** brings together four cutting-edge scenarios that address some of the most persistent challenges in contemporary manufacturing, logistics, and metrology. Each partner contributes a distinct area of expertise—SIPBB, Innovalia, Siemens, MADE Competence Center, and POLIMI—forming a coordinated effort that transforms fragmented innovation into a unified industrial strategy. Rather than functioning as isolated experiments, these pilots interact as complementary elements of one larger ecosystem. Their combined results demonstrate how aerOS can reshape production models, create measurable value, and set new standards for efficiency, precision, and environmental responsibility.

This joint exploitation plan defines the cooperative framework through which all partners will extend aerOS beyond the project's duration. The goal is to translate pilot outcomes into a scalable market offering that strengthens European manufacturing competitiveness and ensures the platform's long-term sustainability as a cornerstone of Industry 4.0 deployment.

Shared Vision

The partners share a single ambition: to reinforce the manufacturing sector with a connected, adaptive, and sustainable digital backbone. By merging the outcomes of all four scenarios, aerOS evolves into a complete solution capable of addressing industrial, environmental, and operational priorities simultaneously.

Key Objectives

- **Advance Sustainable Production:** Apply continuous CO₂ tracking, circular-economy practices, and smart-energy management to reduce carbon intensity across value chains.
- **Achieve Uncompromising Quality:** Extend zero-defect manufacturing and precision metrology to guarantee reliable, traceable production outcomes.
- **Deliver True Flexibility:** Enable agile, modular systems that support lot-size-1 and rapid reconfiguration without disrupting ongoing operations.
- **Streamline Logistics and Orchestration:** Employ decentralized intelligence and optimized AGV coordination to synchronize workflows and shorten lead times.

Synergies Across Partners

Collaboration among the four pilots turns individual strengths into collective advantage. SIPBB contributes deep experience in sustainable factory operations; Innovalia adds precision metrology and cybersecurity expertise; Siemens brings automation, orchestration, and integration of OT–IT domains; MADE and POLIMI provide the experimental facilities, academic insight, and direct access to SMEs needed for real-world validation.

Together, these capabilities demonstrate aerOS as a living, interconnected system—one that bridges research and industry, merges digital and physical production layers, and accelerates Europe’s transition toward fully autonomous, data-driven manufacturing.

Table 30 Synergies Across Partners

Scenario	Key Synergies	Outcome
Scenario 1: SIPBB	- Shared CO₂ monitoring knowledge with other partners - Integration with flexible production systems (Scenario 3)	- Enhanced sustainability in flexible production systems - Real-time environmental impact assessment across scenarios
Scenario 2: Innovalia	- Integration of zero-defect principles into AGV logistics (Scenario 4) - Advanced metrology applied to flexible production (Scenario 3)	- Improved quality assurance in logistics workflows - Elevated precision in customized manufacturing
Scenario 3: Siemens	- Flexible production concepts applied to green manufacturing (Scenario 1) - AI-driven orchestration shared with AGV optimization (Scenario 4)	- Scalable solutions for SMEs focusing on lot-size-1 - Enhanced efficiency through shared AI technologies
Scenario 4: MADE-POLIMI	- Distributed intelligence shared with metrology automation (Scenario 2) - Optimization techniques integrated with sustainability efforts (Scenario 1)	- Real-time optimization across logistics and production - Streamlined operations with reduced environmental impact

Detailed Synergies:

1. Scenario 1 + Scenario 3 CO₂ Tracking and Flexible Production When SIPBB’s hands-on experience with CO₂ monitoring is matched with Siemens’ adaptable production setup, factories can deliver custom products without raising their environmental footprint. It’s a practical mix, small-batch flexibility that still respects sustainability goals.

2. Scenario 2 + Scenario 4 Zero Defects and Smarter Movement Innovalia’s drive for perfect production fits neatly with the automated transport systems from MADE and POLIMI. The two approaches strengthen each other, cutting down on mistakes and delays while keeping materials flowing smoothly through the plant.

3. Scenario 1 + Scenario 4 Smarter Systems for Greener Output Combining MADE and POLIMI’s distributed decision-making tools with SIPBB’s sustainable manufacturing methods gives rise to a setup where machines can tweak their own processes on the spot. The goal is balance, maintaining speed and quality while keeping energy use and waste low.

4. Scenario 2 + Scenario 3 Precision Meets Adaptability When Innovalia’s measurement expertise meets Siemens’ flexible production tools, you get precision that doesn’t slow down customization. Every product can be unique yet still meet tight quality targets, a tough mix to achieve, but this pairing makes it work.

Market Coverage

The aerOS exploitation plan places the platform as a complete and adaptable system that can serve many different parts of the manufacturing world. By combining the strongest results from all four scenarios, aerOS is able to meet what industries need now and stay ready for what’s coming next.

Meeting the Push for Sustainable Manufacturing

Manufacturers are under growing pressure—from both regulations and customers—to prove they can operate responsibly. aerOS tackles that from the start, making sustainability a built-in feature instead of an add-on.

- **Real-Time CO₂ Tracking:** Using SIPBB's monitoring experience, aerOS collects live carbon data throughout production. It gives manufacturers a clear picture of where emissions come from and helps them act quickly to cut waste.
- **Greener Processes:** With Siemens' flexible production methods, aerOS supports the use of low-impact materials and energy-efficient setups. The system also fits with circular economy goals, encouraging reuse and minimizing scrap.
- **Clear Product Information:** Digital Product Passports give end users a transparent look at how each item was made, helping companies earn and keep consumer trust.

Customization Without Slowing Down

As buyers expect more personalized products, manufacturers have to stay efficient while adapting fast. aerOS supports that balance by linking flexibility with automation.

- **Lot-Size-One Production:** Siemens' modular production approach lets factories switch between custom orders with very little downtime.
- **Smarter Scheduling:** AI planning, informed by MADE and POLIMI's AGV optimization work, keeps production lines moving smoothly even when priorities change.
- **Interconnected Systems:** aerOS makes sure machines and software can talk to each other, even if they come from different suppliers.
- **Flexible Supply Chains:** Real-time data exchange keeps suppliers, plants, and logistics in sync, allowing faster reaction to demand changes and reducing excess stock.

Tools for Consistent, Zero-Defect Output

In sectors like aerospace, automotive, or medical manufacturing, precision isn't optional. aerOS strengthens quality control with advanced tools.

- **Metrology Integration:** Building on Innovalia's measurement systems, aerOS adds precise inspection capabilities to production.
- **Live Quality Monitoring:** The platform tracks process data as it happens, catching deviations before they cause defects.
- **Automated Inspections:** AI and machine learning take over repetitive checks, increasing speed and reliability.
- **Continuous Feedback:** Data collected throughout production helps teams fine-tune methods and improve results over time.

Smarter Logistics and Production Flow

Efficiency comes from coordination, and aerOS helps factories achieve that by combining automation with distributed intelligence.

- **Local Decision Power:** Using MADE and POLIMI's edge computing systems, aerOS processes data directly on-site, speeding up responses.
- **Optimized AGV Routing:** Advanced algorithms reduce idle time and keep materials moving efficiently.
- **Connected Operations:** aerOS closes the gap between IT and factory floor systems, preventing communication delays.

- **Targeted Automation:** Routine work is automated, freeing up staff to focus on problem-solving and development.
- **Scalable Setup:** The modular design allows easy scaling up or down depending on demand, with no major system rebuilds.

Other Key Strengths

- **Data Protection:** Built-in cybersecurity features keep sensitive manufacturing data safe and compliant with regulations.
- **Lower Operating Costs:** Reduced waste, better planning, and fewer errors translate directly into savings.
- **Workforce Support:** Simple interfaces and guided automation help operators handle advanced systems with confidence.
- **Innovation-Friendly:** The system's flexibility lets teams test new materials, workflows, and products faster and with less risk.
- **Global Readiness:** aerOS meets international standards, making it easier for companies to expand into new regions.

aerOS brings together sustainability, customization, precision, and efficiency under one platform. It's designed for manufacturers that need to keep up with fast-changing markets while staying environmentally responsible and cost-effective.

7.1.5.1. Lean Canvas

To clearly show the strategic direction of the joint exploitation plan for aerOS, the Lean Model Canvas is presented below in Table 31 and in the following figure:

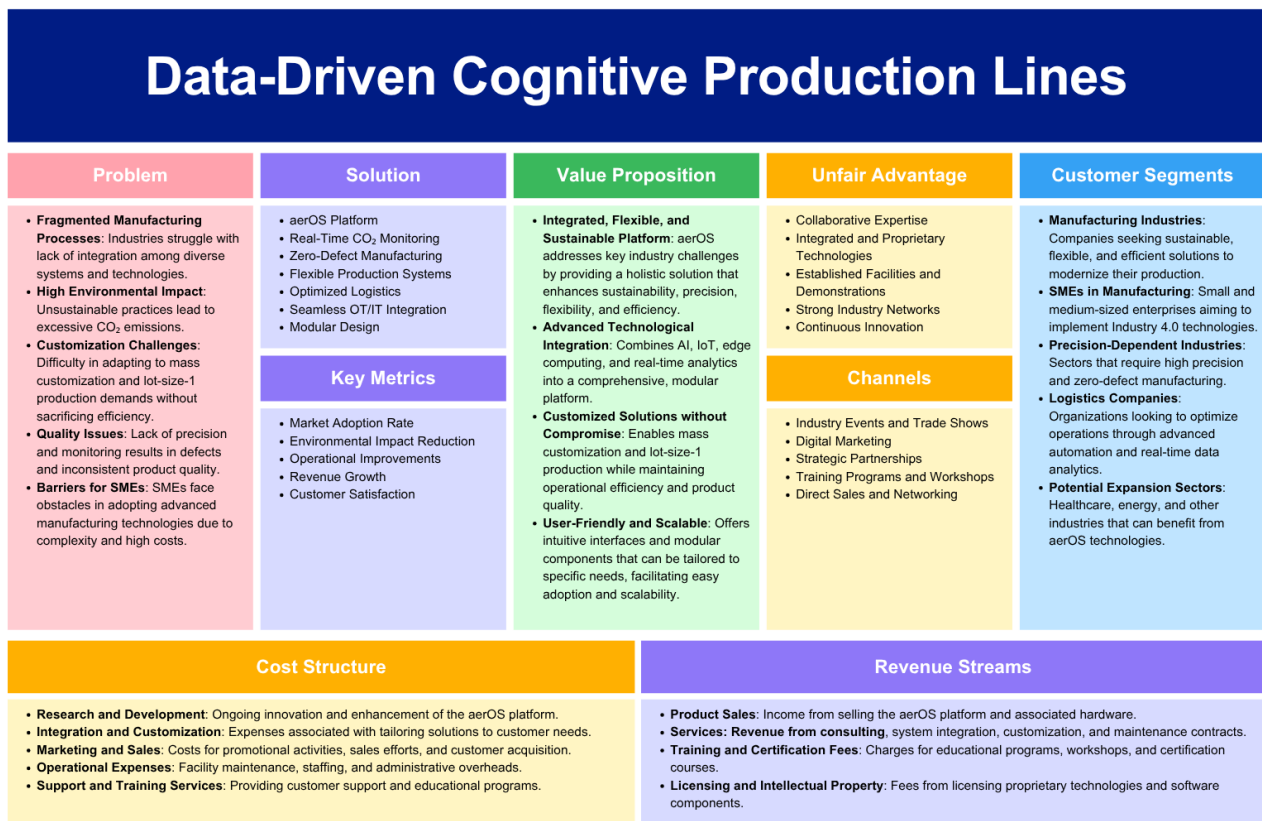


Figure 49 Pilot 1's Business Model Canvas

The table highlights the key parts of the business model, showing how our resources and strategies come together to create strong customer value and support long-term, sustainable growth.

Table 31 Pilot1 Lean Canvas

Lean Canvas Section	Details
Problem	- Fragmented Manufacturing Processes: Industries struggle with inefficiencies due to lack of integration among diverse systems and technologies. - High Environmental Impact: Unsustainable practices lead to excessive CO₂ emissions and resource wastage. - Customization Challenges: Difficulty in adapting to mass customization and lot-size-1 production demands without sacrificing efficiency. - Quality Issues: Lack of precision and real-time monitoring results in defects and inconsistent product quality. - Barriers for SMEs: Small and medium-sized enterprises face obstacles in adopting advanced manufacturing technologies due to complexity and high costs.
Customer Segments	- Manufacturing Industries: Companies seeking sustainable, flexible, and efficient solutions to modernize their production processes. - SMEs in Manufacturing: Small and medium-sized enterprises aiming to implement Industry 4.0 technologies to stay competitive. - Precision-Dependent Industries: Sectors like automotive, aerospace, and medical devices that require high precision and zero-defect manufacturing. - Logistics Companies: Organizations looking to optimize operations through advanced automation and real-time data analytics. - Potential Expansion Sectors: Healthcare, energy, and other industries that can benefit from aerOS technologies.
Unique Value Proposition	- Integrated, Flexible, and Sustainable Platform: aerOS addresses key industry challenges by providing a holistic solution that enhances sustainability, precision, flexibility, and efficiency. - Advanced Technological Integration: Combines AI, IoT, edge computing, and real-time analytics into a comprehensive, modular platform. - Customized Solutions without Compromise: Enables mass customization and lot-size-1 production while maintaining operational efficiency and product quality. - User-Friendly and Scalable: Offers intuitive interfaces and modular components that can be tailored to specific needs, facilitating easy adoption and scalability.
Solution	- AerOS Platform: An integrated system combining innovations from all four scenarios to deliver: - Real-Time CO₂ Monitoring: For sustainable manufacturing practices. - Zero-Defect Manufacturing: Through advanced metrology and quality control. - Flexible Production Systems: Supporting lot-size-1 manufacturing and rapid adaptation to market demands. - Optimized Logistics: Utilizing decentralized intelligence and AGV optimization for efficient workflows. - Seamless OT/IT Integration: Bridges operational technology with information technology for unified operations. - Modular Design: Allows for customization and expansion, adapting to the evolving needs of businesses.
Key Metrics	- Market Adoption Rate: Number of companies and industries implementing aerOS solutions. - Environmental Impact Reduction: Quantifiable decreases in CO₂ emissions and resource consumption.

	- Operational Improvements: Metrics such as reduced lead times, decreased defect rates, and improved production efficiency. - Revenue Growth: Sales figures from products, services, and licensing agreements. - Customer Satisfaction: Feedback scores, repeat business, and customer testimonials indicating the value delivered.
Channels	- Industry Events and Trade Shows: Showcasing aerOS capabilities to a broad audience. - Digital Marketing: Webinars, online campaigns, and content marketing to reach a global market. - Strategic Partnerships: Collaborations with industry associations, technology providers, and regulatory bodies. - Training Programs and Workshops: Offering hands-on experiences and education at partner facilities. - Direct Sales and Networking: Leveraging existing relationships and networks to engage potential customers.
Cost Structure	- Research and Development: Ongoing innovation and enhancement of the aerOS platform. - Integration and Customization: Expenses associated with tailoring solutions to customer needs. - Marketing and Sales: Costs for promotional activities, sales efforts, and customer acquisition. - Operational Expenses: Facility maintenance, staffing, and administrative overheads. - Support and Training Services: Providing customer support and educational programs.
Revenue Streams	- Product Sales: Income from selling the aerOS platform and associated hardware. - Services: Revenue from consulting, system integration, customization, and maintenance contracts. - Training and Certification Fees: Charges for educational programs, workshops, and certification courses. - Licensing and Intellectual Property: Fees from licensing proprietary technologies and software components.
Unfair Advantage	- Collaborative Expertise: Unique partnership among industry leaders with diverse specializations, creating a solution that's difficult to replicate. - Integrated and Proprietary Technologies: Advanced, patented technologies developed through joint R&D efforts. - Established Facilities and Demonstrations: Access to state-of-the-art facilities for showcasing aerOS capabilities and providing hands-on experiences. - Strong Industry Networks: Well-established relationships and influence within the manufacturing sector facilitate market penetration. - Continuous Innovation: Commitment to advancing Industry 4.0 technologies keeps aerOS ahead of competitors.

This Lean Model Canvas captures the main strategy behind the joint exploitation plan for aerOS. It focuses on solving real industry challenges through a strong value proposition and a practical, clearly defined solution. The plan positions aerOS to serve its target customers effectively, using well-chosen channels to reach and engage them. The cost and revenue structure has been shaped to support both financial stability and long-term growth. Our main advantage lies in the depth of our partnership and the unique technologies we've developed together, giving us a clear edge in the market. With measurable goals and key performance indicators guiding progress, the project is set to deliver real value and achieve lasting success.

7.1.5.2. SWOT Analysis

To get a clear picture of where the aerOS platform really stands, we ran a SWOT analysis (see Table 32). It helped us look honestly at what is working well, where the weak spots are, and what kind of chances or threats exist in the wider market. This way, we're not just listing pros and cons, we're building a roadmap that leans on what we do best, fixes the gaps early, and gives aerOS the right footing to grow across the manufacturing world.

Pilot 1 SWOT Analysis Diagram

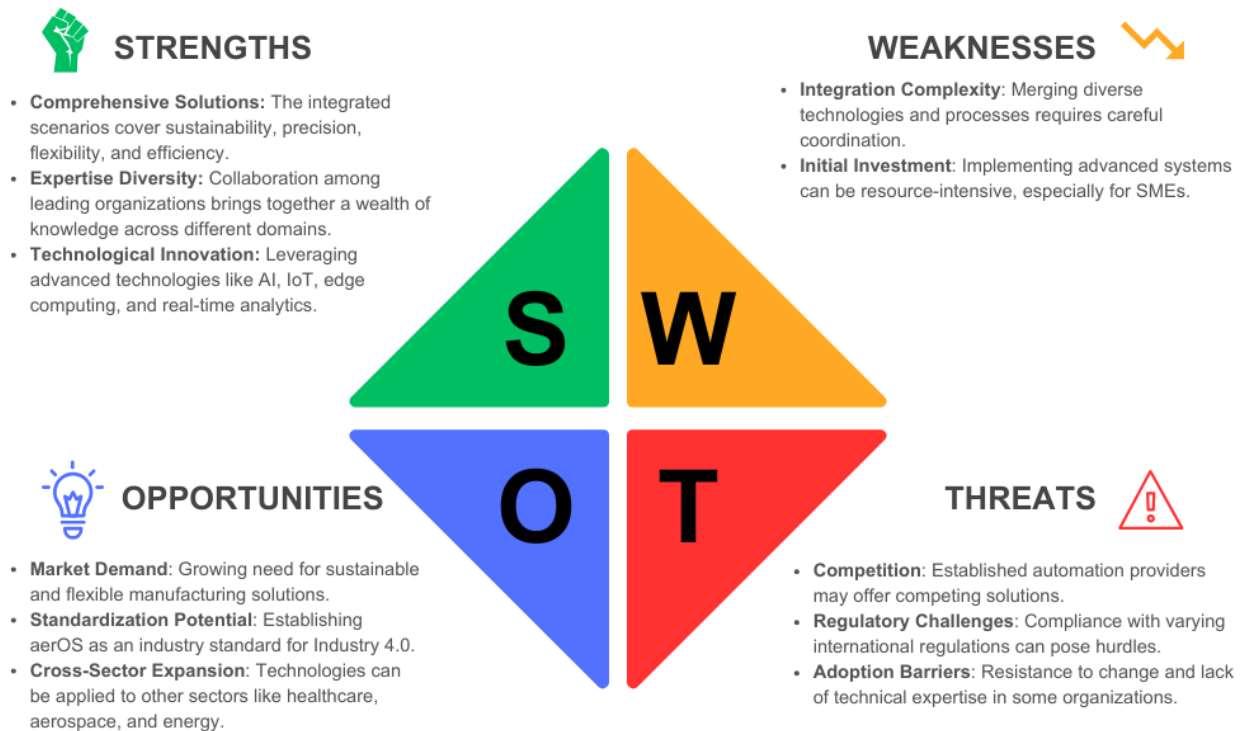


Figure 50 Pilot 1's SWOT Analysis

Table 32 Pilot1-SWOT Analysis

Category	Details
Strengths	Comprehensive Solutions: Integrated scenarios address sustainability, precision, flexibility, and efficiency. Expertise Diversity: Collaboration among leading organizations provides a broad base of knowledge. Technological Innovation: Utilizes AI, IoT, edge computing, and real-time analytics.
Weaknesses	Integration Complexity: Combining diverse technologies and processes requires strong coordination. Initial Investment: High implementation costs, particularly challenging for SMEs.
Opportunities	Market Demand: Rising interest in sustainable and flexible manufacturing solutions. Standardization Potential: Potential to position aerOS as an Industry 4.0 benchmark. Cross-Sector Expansion: Possible applications in healthcare, aerospace, and energy.

Threats	• Competition: Established automation providers may launch similar offerings. • Regulatory Challenges: International compliance requirements may create obstacles. • Adoption Barriers: Resistance to change and limited technical expertise in some organizations.
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The SWOT analysis makes it clear that aerOS has a strong position to make real change in the manufacturing space. Its mix of modern tools and connected solutions gives it a clear edge. Still, there are some tough spots mainly the work needed to bring different systems together and the higher starting costs. These aren't dealbreakers, though; with good planning and smart use of resources, they can be handled. The good news is that market interest is growing fast, and there's real potential for aerOS to set new standards across industries. As long as we stay alert to competition, deal early with regulations, and make adoption easier for users, the project has everything it needs to grow steadily and have a lasting impact.

7.1.5.3. Porter's Five Forces Analysis

To get a clearer picture of how aerOS fits into the current market, we ran a Porter's Five Forces analysis (Table 33). This helps us look beyond internal factors and see what's really shaping competition around us. By examining new market players, supplier and buyer influence, substitute products, and the level of rivalry, we can better understand where the real pressures and opportunities lie.

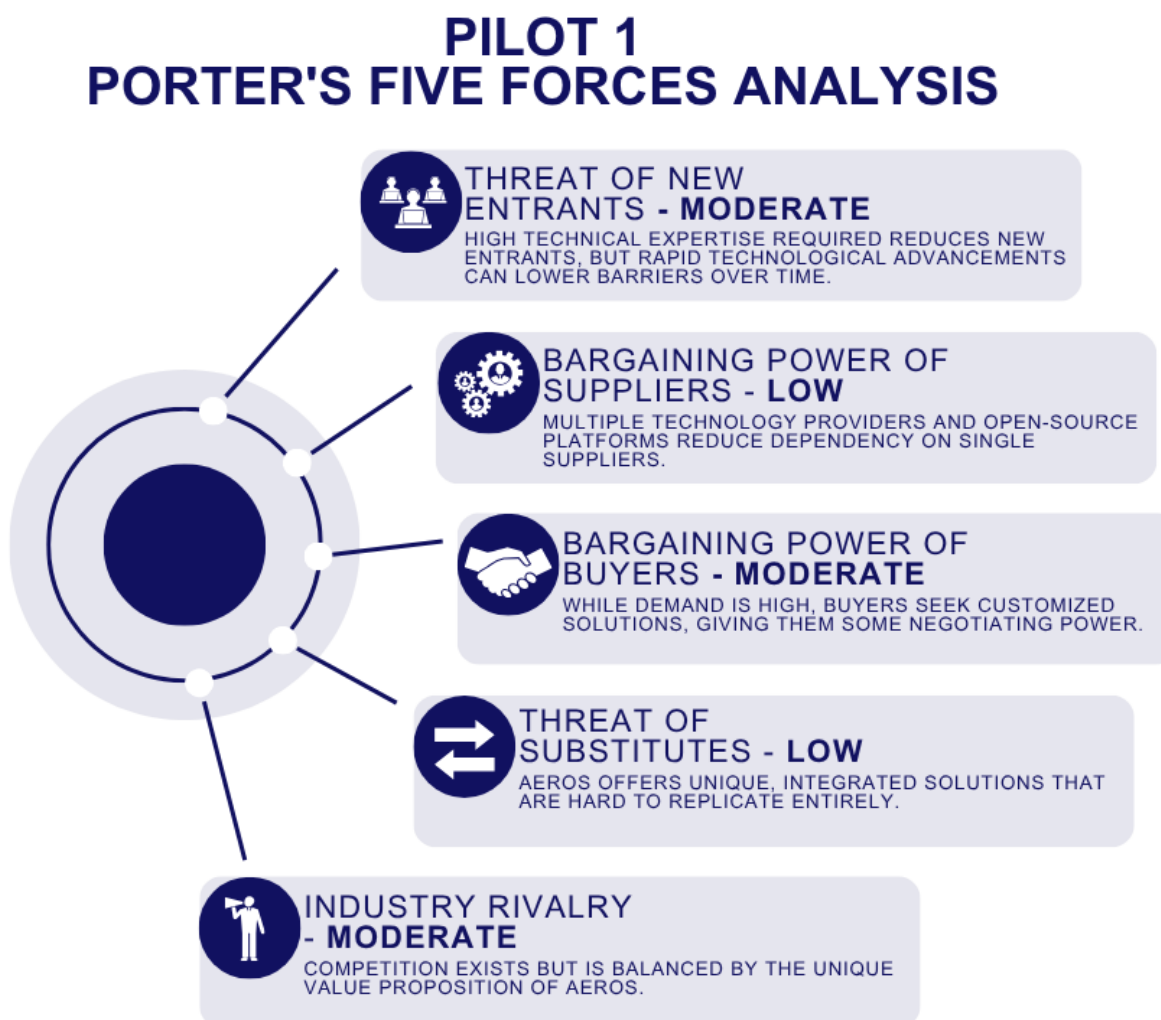


Figure 51 Pilot 1's Porter's Five Forces Analysis

This kind of analysis gives us a practical view of the risks we need to manage and the areas where aerOS can stand out and grow in the wider manufacturing landscape.

Table 33 Pilot1 Porter's Five Forces Analysis

Force	Assessment	Rationale
Threat of New Entrants	Moderate	High technical expertise required reduces new entrants, but rapid technological advancements can lower barriers over time.
Bargaining Power of Suppliers	Low	Multiple technology providers and open-source platforms reduce dependency on single suppliers.
Bargaining Power of Buyers	Moderate	While demand is high, buyers seek customized solutions, giving them some negotiating power.
Threat of Substitutes	Low	aerOS offers unique, integrated solutions that are hard to replicate entirely.
Industry Rivalry	Moderate	Competition exists but is balanced by the unique value proposition of aerOS.

Porter's Five Forces analysis shows that although aerOS faces strong competition, it is in a stable position thanks to its advanced technology and unique solutions. Moderate pressure from new entrants and existing competitors means that we must continue to improve and innovate to stay ahead. On the positive side, suppliers have limited influence and there are few real substitutes, which gives us stability and control. Buyers, however, have some leverage, so it is important to remain agile and continue to offer high-value, customized solutions. Overall, aerOS is well positioned to capitalize on new opportunities while managing the main challenges in the market, laying the foundation for steady growth and long-term success.

7.1.5.4. Llava Matrix

The Llava Matrix is a structured framework designed to integrate user experiences and business model innovation into the development process. By focusing on customer segments, shared needs, value propositions, solutions, value networks, competition, and willingness to pay, this methodology ensures that innovations are not only technically feasible, but also user-centric and financially viable. Applying the Llava Matrix to the aerOS shared ownership plan provides a clear roadmap for incorporating stakeholder feedback, validating business cases, and delivering scalable Industry 4.0 solutions that address key industry challenges. Below is the detailed matrix adapted to the aerOS project.

Table 34 Pilot1 LlavaMatrix

Category	Details
Customer Segment	Primary Customers: 1. Manufacturing Industries: Automotive, aerospace, and medical devices requiring precision and efficiency. 2. Small and Medium-Sized Enterprises (SMEs): SMEs aiming to modernize with Industry 4.0 technologies but facing cost and complexity barriers. 3. Logistics Providers: Organizations optimizing intralogistics through AGVs and advanced automation systems. 4. Sustainability-Focused Enterprises: Companies under regulatory or consumer pressure to adopt greener practices.
Common Need	Operational Challenges: - Need for seamless integration between operational technology (OT) and information technology (IT). - Demand for real-time monitoring, optimization, and decentralized decision-making. Market Drivers:

	- Increasing focus on sustainable manufacturing and logistics solutions. - Growing demand for mass customization (lot-size-1 production) without sacrificing efficiency. Key Pain Points - Difficulty implementing affordable and scalable Industry 4.0 technologies. - High energy consumption and emissions in traditional manufacturing workflows. - Quality inconsistencies leading to defects and waste.
Value Promise	Core Proposition: aerOS offers an integrated, modular, and scalable Industry 4.0 platform that enhances sustainability, precision, flexibility, and efficiency. Key Benefits: - Sustainability: Real-time CO₂ monitoring and green manufacturing practices to meet environmental and regulatory demands. - Customization: Flexible production systems to support lot-size-1 manufacturing and mass customization. - Quality Assurance: Advanced metrology tools and zero-defect manufacturing systems to ensure consistency and reduce waste. - Operational Efficiency: Decentralized intelligence and AGV optimization for streamlined logistics and production workflows.
Solution	Generic Components: - Interoperable APIs and Protocols: Seamless communication across diverse systems. - Edge Computing: Real-time processing at decentralized points, reducing latency and dependence on centralized systems. - AI-Powered Orchestration: Advanced analytics and decision-making for automated optimization of processes. Scenario-Specific Features: - Scenario 1 (SIPBB): Real-time CO₂ tracking for sustainability and energy optimization. - Scenario 2 (Innovalia): Precision metrology tools for zero-defect manufacturing. - Scenario 3 (Siemens): Modular systems enabling lot-size-1 production and flexible workflows. - Scenario 4 (MADE-POLIMI): AGV travel optimization and decentralized logistics intelligence.
Value Network	Roles and Contributions: - Living Labs and Pilot Sites: Facilities like the Swiss Smart Factory, AIC Bilbao, TechHall Nuremberg, and MADE Competence Center act as testing grounds for aerOS solutions. - Partners and Stakeholders: Collaboration between SIPBB, Innovalia, Siemens, MADE, and POLIMI provides expertise in sustainability, precision, logistics, and flexible production. E2E (End-to-End) Value Chain: - Value Creation: aerOS integrates sustainable practices, efficient logistics, and customizable manufacturing to meet evolving market demands. - Value Delivery: AerOS solutions are delivered through modular, user-friendly designs that can be adapted for diverse industrial contexts. - Value Capturing: Revenue is generated through product sales, consulting, training, and certification services.
Competition	Direct Competitors: - Established Automation Providers: Companies like Siemens' proprietary automation tools and Schneider Electric's solutions. - Niche Providers: Specialized companies offering tools for zero-defect manufacturing, CO₂ tracking, or AGV optimization individually. Differentiation: - Integrated Approach: aerOS combines features like CO₂ monitoring, zero-defect

	production, flexible workflows, and AGV optimization into one platform. - Scalability and Modularity: Tailored for both large enterprises and SMEs, aerOS offers affordability and adaptability that competitors often lack. - User-Centric Design: Feedback-driven, intuitive solutions designed to meet real-world user needs.
Willingness to Pay	Pricing Strategy: - Flexible Models: Modular pricing allows customers to adopt only the components they need, reducing initial investment barriers. - Subscription Options: SMEs can opt for subscription-based access to aerOS, reducing upfront costs. - Customized Packages: Tailored pricing for large enterprises based on the scale and complexity of implementation. Customer Value Perception: - Customers are willing to invest in aerOS because it offers: - Tangible cost savings through efficiency and waste reduction. - Compliance with environmental regulations. - Enhanced operational and product quality, leading to improved market competitiveness.

The Llava Matrix provides a structured approach to map the aerOS joint exploitation plan, highlighting its customer-centric and value-driven nature. By addressing specific customer needs, delivering an integrated and differentiated solution, and offering flexible pricing, aerOS positions itself as a transformative platform for Industry 4.0 adoption across diverse sectors. This structured methodology ensures aerOS's long-term sustainability and market success.

7.1.5.5. Strategic Implementation Plan

To realize the full potential of the integrated scenarios, the following strategic actions will be undertaken:

Collaborative Development

- **Unified Platform Integration:**
 - Develop a cohesive aerOS platform that seamlessly incorporates the technologies and innovations from all four scenarios.
 - Ensure interoperability and standardized communication protocols across different systems and devices.
- **Joint R&D Initiatives:**
 - Establish cross-organizational teams to foster innovation and address common challenges.
 - Share resources and expertise to accelerate development and deployment.

Market Penetration Strategy

- **Targeted Marketing:**
 - Promote aerOS as a comprehensive solution at industry events, webinars, and through digital marketing channels.
 - Highlight success stories and case studies demonstrating tangible benefits.
- **Partnerships and Alliances:**
 - Collaborate with industry associations, technology providers, and regulatory bodies to expand reach.
 - Engage with SMEs and large enterprises to tailor solutions to their specific needs.

- **Training and Education:**

- Offer workshops, training programs, and certifications to build technical expertise among customers and partners.
- Leverage the facilities at SIPBB, Innovalia, Siemens, MADE, and POLIMI for hands-on learning experiences.

Scalability and Customization

- **Modular Solutions:**

- Design aerOS components to be modular, allowing customers to adopt features that meet their immediate needs while providing a pathway for future expansion.

- **Flexible Pricing Models:**

- Develop pricing strategies that accommodate different budget levels, including subscription-based models or financing options for SMEs.

- **Continuous Improvement:**

- Implement feedback mechanisms to gather user insights and continuously refine the platform.

7.1.5.6. ROI Analysis

A ROI (Return on Investment) analysis (Table 35) is crucial to understand the value that the aerOS platform brings to its stakeholders. This analysis evaluates the financial gains, and social benefits derived from the joint exploitation of aerOS. By assessing these dimensions, s, we can justify the investments made and strategize for future growth and sustainability.

Table 35 Pilot1 ROI Analysis

Category	Details
Financial ROI	Revenue Streams Product Sales Income from aerOS Solutions and Hardware: The primary source of revenue will come from the sale of the aerOS platform and its associated hardware components. Given the platform's comprehensive capabilities in addressing key industry challenges, there is significant potential for widespread adoption across various sectors. Services Consulting Services: Offering expert guidance on integrating aerOS into existing systems, customizing solutions to meet specific needs, and optimizing operational workflows. Customization and Integration: Tailoring the aerOS platform to fit unique customer requirements, including developing additional modules or features. Maintenance and Support Services: Providing ongoing technical support, software updates, and system maintenance to ensure optimal performance and customer satisfaction. Market Expansion Scaling Across Industries Diversification: Adapting aerOS for use in sectors beyond manufacturing—such as healthcare, aerospace, energy, and logistics—opens new revenue streams and reduces dependency on a single market. Geographical Expansion Global Reach: Expanding into emerging markets and regions with growing industrial sectors increases the customer base and revenue potential. Cost Savings

	Operational Efficiency Reduced Production Costs: By streamlining processes and minimizing waste, aerOS enables companies to lower operational expenses, enhancing profitability. Energy Savings Lower Energy Consumption: Implementing energy-efficient practices reduces utility costs, contributing to the bottom line.
Social ROI	Environmental Impact CO₂ Emission Reduction Sustainable Practices: By promoting green manufacturing and real-time CO₂ monitoring, aerOS contributes to significant reductions in greenhouse gas emissions. Resource Conservation Efficient Use of Materials: Optimizing production processes minimizes waste, preserving natural resources. Economic Growth Empowering SMEs Job Creation: Providing accessible, scalable solutions enables SMEs to grow, creating employment opportunities. Local Economic Development Strengthening Supply Chains: Enhanced capabilities of SMEs boost local economies and encourage further investments in technology. Technological Advancement Advancing Industry 4.0 Adoption Technological Literacy: Widespread implementation of aerOS accelerates the adoption of Industry 4.0 technologies, fostering a more technologically adept workforce. Innovation Culture Encouraging R&D: Success with aerOS inspires additional research and development efforts, driving continuous innovation across industries. Social Benefits Improved Working Conditions - Automation of Hazardous Tasks: Automating repetitive or dangerous tasks enhances worker safety and job satisfaction. - Education and Skills Development - Upskilling the Workforce: Training associated with aerOS equips employees with advanced skills, promoting career advancement and productivity.

The ROI analysis shows that investing in aerOS brings strong benefits on several levels financial, social, and technological. Financially, it creates new business opportunities, cuts operating costs, and strengthens competitiveness. On the social side, it supports sustainability, drives innovation, and contributes to economic growth. Overall, aerOS delivers value not only to its partners but also to the wider community. It aligns with global goals for greener, smarter industries, ensuring that its impact goes beyond short-term profits and leads to lasting, positive change.

7.1.6. Conclusion

Bringing the four scenarios together gives aerOS real strength as one complete system. Each partner adds something different, from sustainability and data precision to flexibility and smarter production, creating a powerful mix that helps modern factories work better.

Working as one team makes aerOS stronger. It encourages shared learning, new ideas, and faster progress. Together, we can help more companies move toward Industry 4.0, cut waste, and build a more efficient and sustainable future.

Main points:

- **Bigger impact:** Teamwork helps us reach more markets and push new technology forward.
- **Lasting growth:** A shared plan keeps aerOS strong and adaptable as the market changes.
- **Better teamwork:** Partners share knowledge and use resources more effectively.
- **Customer focus:** Solutions are built around real business needs to boost adoption.

By following this joint plan, we aim to raise standards in manufacturing and drive positive, lasting change across the industry.

7.2. Joint Exploitation Plan for Pilot 2: Containerized Edge Computing Near Renewable Energy Sources (CF and ELECT)

PPilot 2, run by CloudFerro and ELECT in Poland, focuses on testing small edge data centers powered by renewable energy. The goal is to show how aerOS can manage connected edge and cloud systems in a flexible and energy-efficient way. The pilot tests real-time data handling directly at the edge, supported by a private cloud. This setup helps cut energy use, improve performance, and support the needs of modern factories.

CloudFerro already operates several large public clouds and manages big Earth Observation data stores. With this pilot, the company is moving toward what it calls *Green Edge Processing (GEP)*, a way to combine distributed computing with clean energy.

The setup includes two small container-based edge nodes powered by renewable energy. Each one has:

- Strong bare metal servers for heavy computing tasks
- Kubernetes clusters for running and managing software containers
- Direct links to CloudFerro's private cloud for smooth integration

These nodes run on renewable energy and process data from smart devices locally instead of sending everything to the cloud. The system is also linked to the MADE test site and the POLIMI Industry 4.0 Lab to model what happens when the main site reaches full capacity.

Main Goals and Expected Results

The pilot aims to combine edge computing and renewable energy in a practical way. Its goals are:

1. Process data in real time at the edge to save energy and cut delays.
2. Use smart tools to manage energy and network traffic efficiently.
3. Show that aerOS can scale up or down easily between the edge and cloud.

Expected outcomes:

- Lower energy use and operating costs
- Better performance and coordination between edge and cloud
- Proof that aerOS works well for green, distributed computing

7.2.1. Exploitation Plan – Before/After aerOS Implementation

This exploitation plan explains how the results of Pilot 2 will turn into new services, stronger market activity, and a solid base for future research and development.

Before aerOS, container-based edge computing faced several obstacles. Many teams lacked experience managing containerized edge systems or using extra renewable energy efficiently. Because of this, they relied too much on centralized cloud setups, which raised costs and limited independence.

Tools for saving energy and managing networks were also underdeveloped, making it hard to scale. Centralized cloud systems worked well in stable situations but struggled with fast-changing or resource-heavy applications.

With the arrival of aerOS, this picture changed. Through this pilot, CloudFerro and ELECT learned how to build and run containerized data centers effectively. That knowledge opened the door to new business models such as mobile private clouds, disaster recovery setups, and green data centers powered directly by renewable energy.

The project also showed that aerOS can support flexible edge networks running light AI tools (Frugal AI), which help reduce energy use and improve computing performance. By linking edge nodes directly to renewable power sources, aerOS provides a reliable and cost-efficient setup for heavy data workloads while keeping the environmental footprint low.

Before aerOS

- Little experience managing edge systems or using renewable energy efficiently.
- Strong dependence on centralized clouds, leading to higher costs and energy use.
- No complete tools for managing energy and networks.
- **TRL 5–6:** Tested only in labs, not in real user settings.
- Key challenges: understanding customer needs, network access, and cooling systems.

After aerOS:

- Strong know-how in deploying and operating containerized data centers.
- New services launched, mobile edge clouds, green data centers, and recovery systems.
- Scalable edge network ready for Frugal AI deployment.
- **TRL 7–8:** First industrial-level deployment completed.
- Easier access to new markets thanks to flexible resource scaling.

Main Technological Achievements

- **Distributed Computing Power** aerOS brings computing closer to where data is generated. This reduces the need for large data transfers, cuts energy use, and improves reaction times, a key advantage for sectors like manufacturing and energy.
- **Frugal AI and Machine Learning** Lightweight AI tools help manage networks and workloads more efficiently. They cut energy use and keep systems running smoothly without requiring massive computing power.
- **Data Interoperability** aerOS ensures that equipment from different suppliers can work together. This makes integration easier and helps create unified, flexible systems.
- **Simple APIs** The platform is designed to be easy to configure and adapt, even for people who aren't technical experts. This encourages wider use and faster deployment.

Together, these innovations make aerOS a practical, scalable, and sustainable foundation for industrial computing.

How Success Is Measured

- **Energy Use:** Lower consumption thanks to local data processing.

- **Operational Efficiency:** Faster orchestration and smoother network use.
- **Revenue Growth:** New services create new income streams.
- **Customer Adoption:** Feedback and retention rates show real-world impact.

These measures help track how well aerOS improves performance, reduces energy waste, and adds business value.

Market Landscape

Challenges:

- Ensuring high data security while keeping low-carbon operations.
- Managing the cost of changing energy prices.
- Handling the technical complexity of containerized data centers.

Opportunities:

- Growing demand for sustainable IT solutions.
- Expanding need for edge computing in research, medicine, and Earth observation.
- Long-term service contracts that bring stable revenue.

Value Proposition

Pilot 2 delivers clear value in four main areas:

- **Lower emissions:** Workloads run on renewable-powered edge nodes.
- **Mobility:** Portable edge clouds for emergency or field operations.
- **Scalability:** Infrastructure that grows with demand.
- **Cost efficiency:** Less energy use and fewer data transfer expenses.

This combination makes Pilot 2 a strong player in sustainable and high-performance private cloud solutions.

Looking Ahead

The results of this pilot open several paths forward:

- **Product Development:** New green data centers and edge-cloud services.
- **Research:** More work on Frugal AI and predictive analytics.
- **Market Growth:** Expansion into sectors like research, medicine, and Earth observation.
- **Collaboration:** Stronger links with partners in Europe and beyond.

Pilot 2 proves how aerOS can connect renewable energy and edge computing into one efficient and sustainable system. It lays the foundation for greener, more flexible IT infrastructure and supports CloudFerro and ELECT's leadership in this evolving market.

7.2.2. Joint Exploitation Synergies: Integrating Pilot 2 for Maximum Impact

Pilot 2 aims to show how aerOS can transform the way container-based edge computing and renewable energy work together. This plan explains how CloudFerro and ELECT will join forces to tackle the main challenges in building energy-efficient IT infrastructure. Using the capabilities of aerOS, the project will focus on creating solutions that are sustainable, scalable, and ready to support innovation.

Shared Vision

The goal of Pilot 2 is to rethink how edge and cloud systems operate by combining clean energy, distributed computing, and Frugal AI. Together, these elements will form a modern, adaptable, and sustainable digital framework for industry.

Through this pilot, we aim to:

- **Promote sustainability:** Run edge data centers on renewable energy to cut CO₂ emissions and lower environmental impact.
- **Improve scalability and flexibility:** Create an edge-cloud setup that can easily adjust to workloads in demanding fields like Earth observation and healthcare.
- **Optimize energy and network performance:** Use intelligent tools that manage power and data flow efficiently.
- **Encourage innovation in IT services:** Develop mobile private cloud systems and disaster recovery solutions that run on green energy.

Partner Synergies

CloudFerro and ELECT bring complementary strengths that make this collaboration highly effective. By combining CloudFerro's experience in cloud infrastructure and large-scale data management with ELECT's expertise in renewable energy systems, the project will deliver practical, high-performance solutions for sustainable computing.

This partnership ensures that Pilot 2 not only demonstrates what aerOS can achieve technically but also sets a real-world example of how digital infrastructure can become cleaner, smarter, and more flexible (Table 36).

Table 36 Pilot2 Synergies Across Partners

Key Area	Synergies	Outcome
Edge Computing and Green Energy Integration	- Seamless orchestration of containerized data centers powered by renewable energy sources. - Efficient utilization of surplus green energy.	- Creation of scalable and sustainable edge networks with reduced operational costs and carbon footprint.
Distributed Computing	- Real-time analytics performed at edge nodes. - Minimization of data transmission to central clouds.	- Enhanced system responsiveness and reduced energy consumption. - Greater autonomy in data processing for industries with latency-sensitive needs.
Frugal AI/ML Integration	- Deployment of lightweight AI models for energy and network optimization. - Edge-based decision-making for resource allocation.	- Significant reduction in energy consumption and improved operational efficiency. - Intelligent orchestration of workloads across edge-cloud systems.
Data Interoperability	- Use of standardized protocols for seamless integration of diverse edge nodes and components.	- Unified system architecture ensuring compatibility across multiple vendors and applications. - Simplified management of distributed systems.

Detailed Synergies

1. Edge Computing and Renewable Energy:

- **Synergy:** Integrating edge nodes with renewable energy sources and optimizing energy usage through aerOS.

- **Outcome:** Real-time energy-efficient data processing and scalable IT services with reduced environmental impact.

2. Distributed Computing and Frugal AI:

- **Synergy:** Combining distributed computing with lightweight AI models for energy- and network-conscious operations.
- **Outcome:** Improved system autonomy and responsiveness while minimizing operational costs.

3. Mobile Cloud Services and Disaster Recovery:

- **Synergy:** Deploying containerized, mobile edge data centers for rapid deployment in disaster recovery or remote operations.
- **Outcome:** Flexible, reliable solutions for critical applications, with quick scalability and minimal setup time.

4. Interoperability and Scalability:

- **Synergy:** Ensuring seamless communication and scalability through interoperable data protocols and aerOS APIs.
- **Outcome:** Simplified management of large-scale, distributed edge-cloud networks tailored to dynamic industrial needs.

Metrics for Success

To evaluate the effectiveness and long-term viability of Pilot 2, a structured performance framework has been established, linking technical, environmental, and economic indicators to the pilot's strategic objectives. This ensures measurable validation of aerOS's impact while situating its results within the broader market context (Table 37).

Table 37 Pilot2 Metrics for Success

Metric	Description	Target Outcome
Energy Efficiency	Reduction in energy consumption due to edge-based processing and optimized resource allocation.	Significant decreases in energy costs and CO ₂ emissions, supporting sustainability goals.
Operational Performance	Enhanced system responsiveness, reduced network congestion, and improved data flow across nodes.	Streamlined orchestration with minimal latency and bottlenecks.
Revenue Growth	Financial gains from new service offerings, such as mobile edge solutions and disaster recovery.	Tangible revenue streams from innovative, scalable IT solutions.
Customer Adoption	Number of new clients adopting aerOS-powered edge solutions and retention rates.	Widespread adoption across industries like healthcare, Earth observation, and renewable energy management.

In parallel, external market dynamics, such as digitalization trends, sustainability regulations, and emerging technological standards, play a critical role in shaping Pilot 2's exploitation pathway. The following Table 38 summarizes the main challenges and opportunities influencing its commercialization potential

Table 38 Pilot2 Market Challenges and Opportunities

Challenges	Opportunities
Lack of familiarity with edge-cloud integration powered by green energy.	Growing demand for green IT solutions and regulatory pressures to reduce carbon footprints.

Concerns about data security in edge-cloud architectures.	Increasing need for private, secure edge-cloud systems tailored to specific
Infrastructure complexity and high technical expertise required for containerized edge nodes.	Differentiation through aerOS's user-friendly APIs and streamlined deployment of containerized data centers powered by renewable energy.
Volatility of renewable energy supply and dynamic energy costs.	Strategic edge node placement near cost-effective renewable energy sources ensures cost optimization and operational reliability.

Post-Project Vision

The conclusion of Pilot 2 sets the stage for long-term impact, expanding aerOS's footprint in sustainable IT infrastructure and edge-cloud services.

Product Development:

- **Mobile Green Data Centers:** Portable, renewable energy-powered data centers for disaster recovery and remote IT services.
- **Edge-Based Cloud Solutions:** Customizable edge-cloud systems for industries requiring high performance and low environmental impact.
- **Frugal AI Offerings:** Lightweight AI/ML tools for optimizing edge-cloud operations across diverse industries.

Advanced Research and Development:

- **AI-Driven Optimization:** Enhance Frugal AI models to predict and allocate energy and computing resources more effectively.
- **Renewable Energy Integration:** Develop mechanisms for dynamic load balancing and surplus energy utilization.

Market Expansion:

- **Emerging Sectors:** Extend solutions to high-demand industries such as Earth observation, medical imaging, and research institutions.
- **Geographical Outreach:** Expand into regions with growing renewable energy infrastructure to establish a global presence in green IT.

Collaborative Networks:

- Strengthen partnerships with renewable energy providers, research institutions, and technical collaborators to foster joint R&D and knowledge-sharing initiatives.
- Engage with European and international ecosystems focused on edge-cloud computing and green energy to accelerate adoption.

Pilot 2 plays a critical role in the broader aerOS vision by complementing the capabilities demonstrated in Pilot 1. Together, these pilots showcase the full potential of aerOS as a modular, scalable, and sustainable Industry 4.0 platform Table 40:

Table 39 Pilot 2 into the Broader aerOS Platform

Key Aspect	Pilot 1 Contribution	Pilot 2 Contribution	Unified Outcome
Sustainability	Real-time CO ₂ monitoring and green manufacturing practices.	Renewable energy-powered edge computing.	End-to-end sustainability, from production to IT infrastructure.
Flexibility	Modular lot-size-1 manufacturing systems.	Scalable, portable edge data centers for dynamic workloads.	Scalable solutions across manufacturing, logistics, and IT operations.

Operational Efficiency	AI-driven orchestration for manufacturing and logistics workflows.	Frugal AI for energy- and network-conscious edge-cloud operations.	Seamless orchestration across physical production systems and IT infrastructures.
Innovation Leadership	Advanced metrology and zero-defect manufacturing tools.	Cutting-edge private cloud services integrated with renewable energy.	Industry leadership in both manufacturing excellence and sustainable IT solutions.
Market Impact	Broad applicability in manufacturing, logistics, and precision industries.	Expansion into IT-centric sectors like research, healthcare, and Earth observation.	Extended market reach across both industrial and IT domains.

Pilot 2 shows how renewable energy can power edge-cloud computing without causing any slowdowns or drops in efficiency. The design uses shared computing power, lightweight AI tools, and small, container-based edge units to cut down on energy use and carbon emissions. It also fixes common IT problems like slow response times and high operating costs.

It's interesting to note that going green doesn't mean losing power. The pilot shows that smart design and sustainable energy can work together in the real world and still make money. The work of CloudFerro, ELECT, and their partners shows that cPilot 2 can run on renewable energy without slowing down or losing efficiency. The idea uses shared processing power, lightweight AI tools, and small, container-based edge units to lower energy use and carbon emissions. It also fixes common IT problems like slow response times and high operating costs.

You need to know that going green doesn't mean giving up power. The pilot shows that smart design and renewable energy can work together in the real world and still make money. CloudFerro, ELECT, and their partners show that working together can make new technology that lasts a long time.

You can use this method again in a lot of other places. Hospitals, research labs, and disaster recovery systems can all use it. More people using this setup could help the aerOS movement find a better way to get to greener digital systems. Working together to make new, long-lasting technology.

You can use this method again in many different areas. It can be used in hospitals, research labs, and systems for recovering from disasters. If more people use this setup, it could help the aerOS movement take a new, more useful path toward more eco-friendly digital systems. Pilot 2 shows that renewable energy can be used to power edge-cloud computing without causing any slowdowns or drops in efficiency. The design uses shared computing power, lightweight AI tools, and small, container-based edge units to cut down on energy use and carbon emissions. It also fixes common IT problems like slow response times and high operating costs.

It's interesting to note that going green doesn't mean losing power. The pilot shows that smart design and sustainable energy can work together in the real world and still make money. CloudFerro, ELECT, and their partners' work shows how working together can lead to new, long-lasting technology.

This method can be used again in a lot of different areas. It can be used in hospitals, labs, and systems for recovering from disasters. If more people use this setup, it could help the aerOS movement find a new, more useful way to make digital systems that are better for the environment.

7.2.3. Lean Canvas

The **Lean Canvas** (Table 34) provides a concise framework to outline the business model for Pilot 2, focusing on containerized edge computing integrated with renewable energy sources.

In the next figure, the Lean Canvas model analysed for Pilot 2 can be discovered:

Containerized Edge Computing Near Renewable Energy Sources

Problem	Solution	Value Proposition	Unfair Advantage	Customer Segments
Fragmented Cloud-Edge Architectures: Limited expertise in managing containerized edge nodes and utilizing surplus renewable energy effectively. High Energy Costs and Environmental Impact: Centralized cloud systems rely on traditional energy sources, driving up operational costs and emissions. Latency and Network Bottlenecks: Over-reliance on centralized data processing causes delays and inefficiencies, particularly in latency-sensitive applications. Infrastructure Complexity: Managing containerized edge systems requires advanced expertise in cooling, energy, and network management.	- Containerized Edge Nodes - Distributed Computing Architecture - Frugal AI and Machine Learning - User-Friendly APIs	Pilot 2 delivers a sustainable, scalable, and energy-efficient edge-cloud infrastructure that integrates renewable energy to power real-time processing and reduce operational costs. Sustainability: CO₂ emissions are reduced by leveraging renewable energy sources for edge computing. Flexibility and Mobility: Portable, containerized solutions adaptable to diverse operational contexts, including disaster recovery and dynamic workloads. Cost-Effectiveness: Energy-efficient operations significantly lower energy and data transmission costs. High Performance: Real-time edge analytics ensures responsive and reliable IT operations for data-intensive industries.	- Proprietary Integration - Collaborative Expertise - Scalability and Modularity - Frugal AI Innovation	Sustainability-Focused Enterprises: Organizations seeking to reduce their carbon footprint while maintaining IT performance. Data-Intensive Industries: Research institutions, healthcare, and Earth observation agencies requiring high-performance, eco-friendly edge-cloud solutions. Emergency Response and Disaster Recovery: Customers needing portable, scalable IT solutions for rapid deployment in disaster zones. SMEs with IT Needs: Small and medium enterprises aiming to access affordable and flexible private cloud services.
		Key Metrics	Channels	
		- Energy Efficiency - Operational Performance - Customer Adoption - Revenue Growth	- Direct Sales and Partnerships - Industry Events and Demonstrations - Digital Marketing - Collaborative Ecosystems	
Cost Structure		Revenue Streams		
Research and Development: Investment in AI/ML algorithms, containerized edge technologies, and renewable energy integration. Infrastructure and Maintenance: Costs associated with edge node setup, cooling systems, and energy management tools. Marketing and Sales: Promotional activities, including participation in industry events and digital outreach campaigns. Customer Support and Training: Ongoing technical support and training services for clients adopting the platform.		Product Sales: Sales of containerized edge nodes integrated with renewable energy sources. Services: Revenue from private cloud solutions, disaster recovery services, and system integration. Subscription-Based Models: Offering edge-cloud services on a subscription basis for SMEs and other enterprises. Consulting and Training: Fees for technical consulting and workforce upskilling in edge-cloud and renewable energy solutions.		

Figure 52 Pilot 2's Business Model Canvas

Table 40 Pilot2 Lean Canvas

Category	Details
Problem	Fragmented Cloud-Edge Architectures: Limited expertise in managing containerized edge nodes and utilizing surplus renewable energy effectively. High Energy Costs and Environmental Impact: Centralized cloud systems rely on traditional energy sources, driving up operational costs and emissions. Latency and Network Bottlenecks: Over-reliance on centralized data processing causes delays and inefficiencies, particularly in latency-sensitive applications. Infrastructure Complexity: Managing containerized edge systems requires advanced expertise in cooling, energy, and network management.
Customer Segments	Sustainability-Focused Enterprises: Organizations seeking to reduce their carbon footprint while maintaining IT performance. Data-Intensive Industries: Research institutions, healthcare, and Earth observation agencies requiring high-performance, eco-friendly edge-cloud solutions. Emergency Response and Disaster Recovery: Customers needing portable, scalable IT solutions for rapid deployment in disaster zones. SMEs with IT Needs: Small and medium enterprises aiming to access affordable and flexible private cloud services.
Value Proposition	Pilot 2 delivers a sustainable, scalable, and energy-efficient edge-cloud infrastructure that integrates renewable energy to power real-time processing and reduce operational costs.

	Sustainability: CO₂ emissions are reduced by leveraging renewable energy sources for edge computing. Flexibility and Mobility: Portable, containerized solutions adaptable to diverse operational contexts, including disaster recovery and dynamic workloads. Cost-Effectiveness: Energy-efficient operations significantly lower energy and data transmission costs. High Performance: Real-time edge analytics ensures responsive and reliable IT operations for data-intensive industries.
Solution	Containerized Edge Nodes: Powered by renewable energy and optimized for real-time analytics and local data processing. Distributed Computing Architecture: Reduces reliance on centralized clouds, enhancing autonomy and minimizing latency. Frugal AI and Machine Learning: Lightweight algorithms optimize energy consumption and network orchestration. User-Friendly APIs: Simplified system management allows customization and deployment without extensive technical expertise.
Key Metrics	Energy Efficiency: Measured by reductions in energy usage and CO₂ emissions. Operational Performance: Evaluated through latency reduction, improved data flow, and enhanced edge-cloud orchestration. Customer Adoption: Number of clients adopting the solution, retention rates, and user satisfaction scores. Revenue Growth: Revenue generated through new service offerings such as mobile edge private cloud solutions and disaster recovery systems.
Channels	Direct Sales and Partnerships: Collaboration with renewable energy providers, system integrators, and IT service vendors. Industry Events and Demonstrations: Showcasing the solution at sustainability and IT conferences, including live demonstrations. Digital Marketing: Webinars, case studies, and content marketing targeting sustainability-conscious enterprises and IT-heavy industries. Collaborative Ecosystems: Participation in European and global edge-cloud innovation networks for knowledge sharing and technology promotion.
Cost Structure	Research and Development: Investment in AI/ML algorithms, containerized edge technologies, and renewable energy integration. Infrastructure and Maintenance: Costs associated with edge node setup, cooling systems, and energy management tools. Marketing and Sales: Promotional activities, including participation in industry events and digital outreach campaigns. Customer Support and Training: Ongoing technical support and training services for clients adopting the platform.
Revenue Streams	Product Sales: Sales of containerized edge nodes integrated with renewable energy sources. Services: Revenue from private cloud solutions, disaster recovery services, and system integration. Subscription-Based Models: Offering edge-cloud services on a subscription basis for SMEs and other enterprises.

	Consulting and Training: Fees for technical consulting and workforce upskilling in edge-cloud and renewable energy solutions.
Unfair Advantage	Proprietary Integration: Unique ability to combine renewable energy sources with containerized edge computing for sustainable IT infrastructure. Collaborative Expertise: Partnership between CloudFerro and ELECT provides a strong foundation in edge computing and green energy management. Scalability and Modularity: Flexible, portable solutions tailored to diverse industries and operational needs. Frugal AI Innovation: Lightweight AI/ML models offer energy- and network-conscious optimizations, setting Pilot 2 apart from competitors.

Pilot 2's Lean Canvas outlines a business model focused on sustainability, scalability, and innovation. By addressing pressing IT infrastructure challenges and capitalizing on emerging market opportunities, Pilot 2 is positioning itself as a leader in green IT and edge-cloud computing. This approach not only drives immediate results, but also creates a path for long-term growth and industry leadership.

7.2.4. SWOT Analysis

The SWOT Analysis offers a strategic framework to evaluate the internal strengths and weaknesses, as well as the external opportunities and threats, associated with Pilot 2

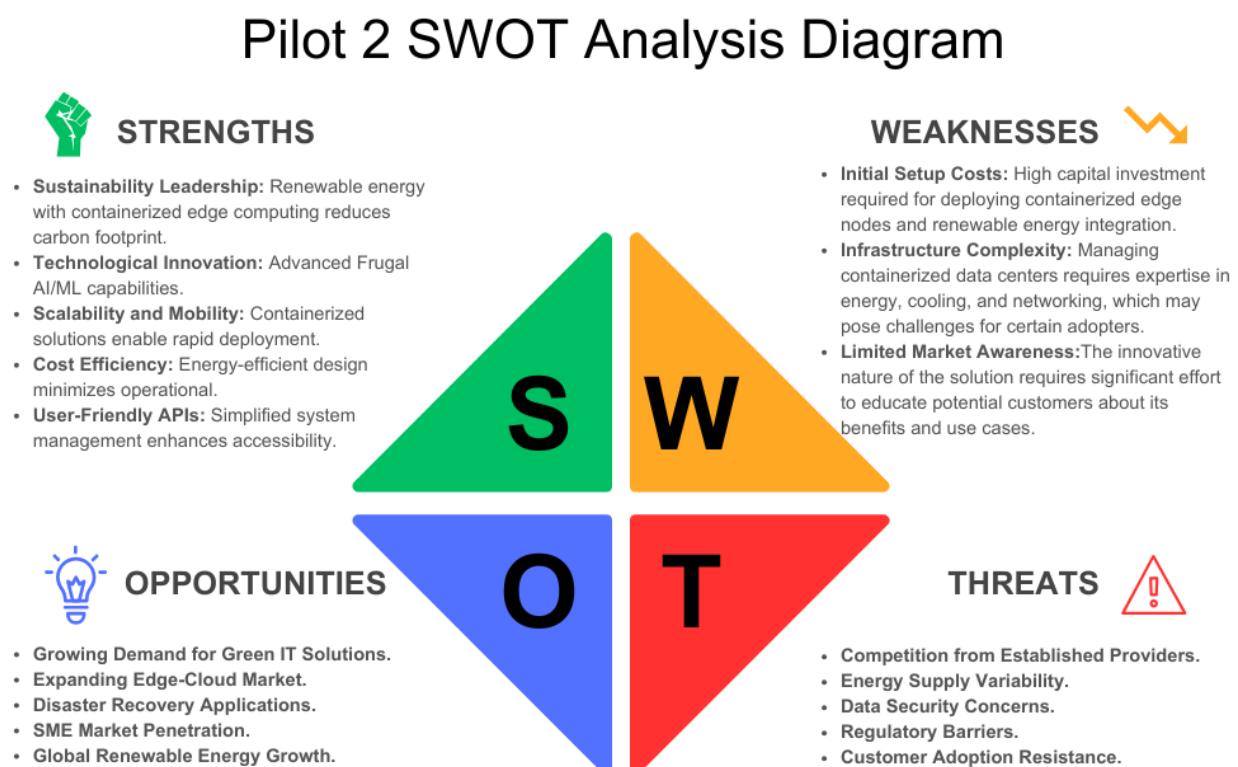


Figure 53 Pilot 2's SWOT Analysis

Table 41 Pilot2 SWOT Analysis

Category	Details
Strengths	Sustainability Leadership: Integration of renewable energy with containerized edge computing reduces carbon footprint, aligning with global sustainability goals. Technological Innovation: Advanced Frugal AI/ML capabilities for energy and network optimization set the solution apart from traditional edge-cloud architectures. Scalability and Mobility: Portable, containerized solutions enable rapid deployment in dynamic environments, including disaster recovery and remote operations. Cost Efficiency: Energy-efficient design minimizes operational costs while maintaining high-performance computing capabilities. User-Friendly APIs: Simplified system management enhances accessibility, even for organizations with limited technical expertise.
Weaknesses	Initial Setup Costs: High capital investment required for deploying containerized edge nodes and renewable energy integration. Infrastructure Complexity: Managing containerized data centers requires expertise in energy, cooling, and networking, which may pose challenges for certain adopters. Limited Market Awareness: The innovative nature of the solution requires significant effort to educate potential customers about its benefits and use cases.
Opportunities	Growing Demand for Green IT Solutions: Increasing regulatory and consumer focus on sustainability creates a strong market for renewable energy-powered IT infrastructure. Expanding Edge-Cloud Market: Rising adoption of edge computing in industries like Earth observation, healthcare, and research provides a large potential customer base. Disaster Recovery Applications: Mobile, containerized edge nodes are ideal for emergency response and disaster recovery scenarios, offering a unique market niche. SME Market Penetration: Scalable and cost-efficient solutions open new opportunities to serve small and medium-sized enterprises with limited budgets. Global Renewable Energy Growth: Expanding green energy infrastructure worldwide provides opportunities for strategic placement of edge nodes near renewable energy sources.
Threats	Competition from Established Providers: Large cloud service providers and IT infrastructure companies may develop competing solutions with more established market presence. Energy Supply Variability: Dependence on renewable energy sources can lead to operational challenges during periods of inconsistent energy generation. Data Security Concerns: Potential customers may be hesitant to adopt edge-cloud solutions due to concerns about data privacy and security in decentralized systems. Regulatory Barriers: Varying international regulations on data processing and renewable energy use may complicate global scalability. Customer Adoption Resistance: Lack of familiarity with edge-cloud solutions and renewable energy integration may slow adoption rates among traditional industries.

The SWOT analysis highlights Pilot 2's strong position as a leader in sustainable and scalable IT infrastructure, driven by advanced technology and innovative edge-cloud integration. While initial setup costs and market awareness present challenges, the growing demand for green IT solutions and the expanding edge-cloud market create significant opportunities for success. Strategic focus on mitigating threats like energy variability and data security will further strengthen Pilot 2's market positioning and long-term viability.

7.2.5. Llava Matrix

The **Llava Matrix** offers a structured framework to integrate user experiences, business models, and iterative testing into the exploitation strategy for Pilot 2. Below is the tailored matrix (Table 43) for this joint exploitation plan:

Table 42 Pilot2 Llava matrix

Category	Details
Customer Segment	Sustainability-Focused Enterprises: Companies aiming to reduce CO₂ emissions while maintaining IT performance. Data-Intensive Industries: Research institutions, healthcare organizations, and Earth observation agencies requiring real-time data processing. Disaster Recovery and Emergency Response: Organizations needing portable, scalable IT infrastructure for quick deployment in disaster zones. Small and Medium Enterprises (SMEs): Businesses seeking affordable and scalable edge-cloud solutions with low environmental impact.
Common Need	Green IT Solutions: Increasing demand for IT infrastructure that reduces carbon emissions while ensuring high performance. Scalability and Flexibility: Need for edge-cloud architectures that adapt to dynamic workloads and operational contexts. Cost-Efficiency: Desire to lower energy consumption and operational costs through efficient energy management. Reliable IT Performance: Industries requiring latency-sensitive, high-computing-power solutions for critical applications.
Value Promise	Pilot 2 delivers sustainable, scalable, and cost-efficient edge-cloud computing powered by renewable energy to revolutionize IT infrastructure. Key Benefits: Environmental Impact: Reduces CO₂ emissions through renewable energy integration. Mobility: Portable edge data centers cater to dynamic workloads and disaster recovery needs. Cost Savings: Lowers operational costs via Frugal AI for energy-conscious and network-efficient operations. Real-Time Analytics: Enhanced system responsiveness for latency-sensitive and data-intensive applications.
Solution	Key Features: Containerized Edge Nodes: Designed for portability, powered by renewable energy, and optimized for real-time analytics. Frugal AI Integration: Lightweight AI/ML algorithms for energy-efficient resource allocation and network management. Distributed Computing Architecture: Processes data locally to minimize latency and energy transmission costs. User-Friendly APIs: Simplifies customization and integration for non-experts, enhancing accessibility. Standardized Protocols: Ensures interoperability across diverse systems and vendors.
Value Network	Key Stakeholders:

	CloudFerro and ELECT: Primary drivers of innovation, development, and deployment of containerized edge computing solutions. Renewable Energy Providers: Partners supplying sustainable energy sources for edge nodes. Research Institutions and SMEs: Early adopters validating and showcasing the platform's capabilities in diverse use cases. Collaborative Ecosystems: Participation in European and global edge-cloud innovation networks for joint R&D and knowledge-sharing initiatives. Value Chain: Development: Design containerized edge nodes optimized for renewable energy and dynamic workloads. Deployment: Implement solutions across industries like healthcare, Earth observation, and disaster recovery. Delivery: Provide modular and scalable services tailored to client needs, supported by aerOS capabilities.
Competition	Key Competitors: Established Cloud Providers: Companies like AWS and Microsoft Azure focus on centralized cloud solutions. Specialized IT Infrastructure Providers: Competitors offering traditional edge computing without renewable energy integration. Differentiation: Renewable Energy Integration: Unique focus on green IT infrastructure sets Pilot 2 apart from traditional solutions. Portability: Containerized, mobile solutions cater to unique use cases like disaster recovery and dynamic deployments. Frugal AI: Lightweight AI solutions optimize efficiency, reducing operational costs and energy usage.
Willingness to Pay	Customer Motivation: High Sustainability ROI: Organizations are willing to invest in solutions that deliver measurable CO₂ reductions and align with sustainability goals. Cost-Effective Solutions: SMEs and other cost-sensitive customers value affordable, subscription-based pricing models. Tailored Use Cases: Industries like healthcare and research value the platform's ability to cater to specific, high-performance needs. Pricing Models: Product Sales: Direct sales of containerized edge nodes integrated with renewable energy solutions. Subscription Services: Flexible, pay-as-you-go pricing for private edge-cloud services and disaster recovery solutions. Consulting and Training: Revenue from consulting services and workforce training in renewable-powered edge-cloud management.

The Llava Matrix for Pilot 2 highlights the integrated approach to addressing customer needs, delivering unique value, and leveraging partnerships for market success. By combining sustainable IT infrastructure with innovative technologies like Frugal AI and portable edge solutions, Pilot 2 establishes itself as a transformative

force in the edge-cloud ecosystem. This structured framework ensures that Pilot 2 not only meets immediate operational goals but also lays the foundation for long-term industry leadership in green IT solutions.

7.2.6. Porter's Five Forces Analysis

This analysis evaluates the competitive environment for Pilot 2 and its potential to establish itself as a leader in green IT and edge computing.

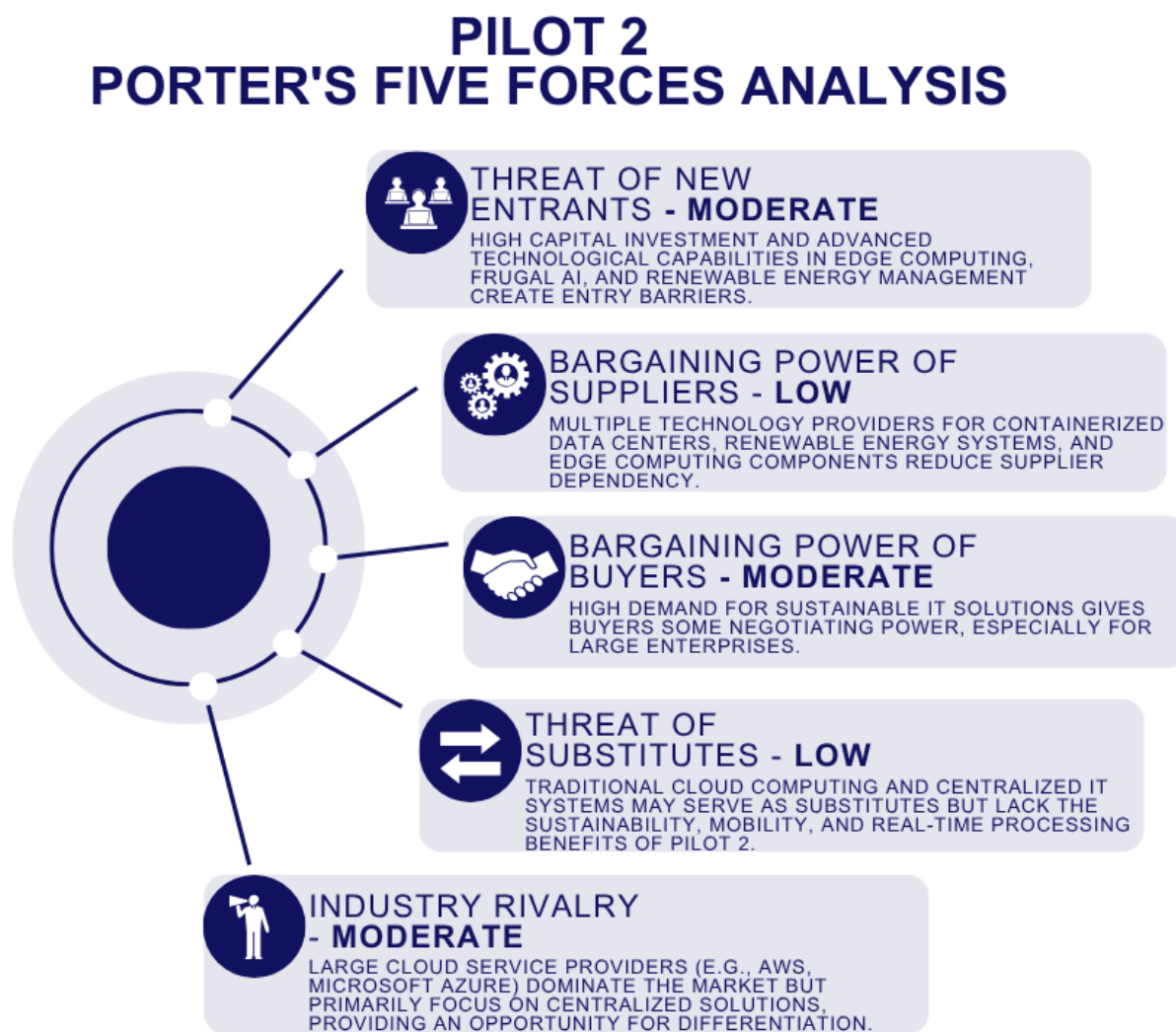


Figure 54 Pilot 2's Porter's Five Forces Analysis

Table 43 Pilot2 Porter's Five Forces Analysis

Force	Details
Threat of New Entrants (Moderate)	Barriers to Entry: High capital investment required for deploying containerized edge nodes and integrating renewable energy sources. Advanced technological capabilities in edge computing, Frugal AI, and renewable energy management create entry barriers. Challenges for New Entrants: Expertise in managing infrastructure complexity (cooling, energy, networking) is a significant hurdle. Regulatory requirements for renewable energy and edge-cloud solutions can deter new players. Risk Factor: Rapid technological advancements and open-source tools may lower barriers for new entrants in the future.

Bargaining Power of Suppliers (Low)	Supplier Availability: Multiple technology providers for containerized data centers, renewable energy systems, and edge computing components reduce supplier dependency. Switching Costs: Standardized APIs and interoperable components in aerOS minimize the cost and complexity of switching suppliers. Supplier Influence: Renewable energy suppliers may have some influence on pricing, but the growing global focus on green energy ensures a competitive supplier landscape.
Bargaining Power of Buyers (Moderate)	Customer Demand: High demand for sustainable IT solutions gives buyers some negotiating power, especially for large enterprises. Market Differentiation: Unique integration of renewable energy and edge computing reduces the availability of direct substitutes, limiting buyer power. Price Sensitivity: Small and medium enterprises (SMEs) may exhibit price sensitivity, requiring flexible pricing models to ensure adoption. Customer Dependency: High switching costs for customers due to infrastructure customization and integration with aerOS APIs reduce their power.
Threat of Substitutes (Low)	Competing Technologies: Traditional cloud computing and centralized IT systems may serve as substitutes but lack the sustainability, mobility, and real-time processing benefits of Pilot 2. Differentiation Advantage: Pilot 2's renewable energy integration, containerized mobility, and Frugal AI-driven efficiency are difficult to replicate in centralized systems. Customer Loyalty: Industries with strict sustainability goals (e.g., healthcare, research) and latency-sensitive needs (e.g., Earth observation) have limited viable alternatives.
Industry Rivalry (Moderate)	Competitive Landscape: Large cloud service providers (e.g., AWS, Microsoft Azure) dominate the market but primarily focus on centralized solutions, providing an opportunity for differentiation. Key Differentiators for Pilot 2: Focus on renewable energy integration and portability gives Pilot 2 an edge over traditional IT infrastructure providers. Market Saturation: The edge-cloud market is growing, reducing direct competition in the short term but likely to increase rivalry as the market matures. Customer Retention: High switching costs due to customization and the unique aerOS value proposition (e.g., Frugal AI and distributed edge computing) help mitigate rivalry risks.

To get a clearer view of where Pilot 2 stands in the market, a Porter's Five Forces review was carried out. The goal was to understand the main outside factors shaping the edge-cloud and green IT space, how tough it is for new players to enter, how much sway suppliers and buyers have, what alternatives might exist, and how strong the overall competition is.

The analysis shows that Pilot 2 is in a good position. Its focus on sustainable and energy-efficient computing gives it a distinct edge in a market that's moving fast toward greener digital solutions. There's no question that competition and customer expectations will keep rising, but the project's mix of innovation, adaptability, and environmental awareness provides a strong foundation. Keeping customers close, staying flexible on pricing, and making its advantages better known will all help Pilot 2 grow and hold its ground over time.

7.2.7. Conclusion

Pilot 2 shows that renewable energy can power edge-cloud computing without slowing it down or making it less useful. The architecture uses lightweight AI tools, small edge units that are based on containers, and shared processing power to use less energy and make less carbon. It also helps with common IT problems like slow response times and high running costs. What stands out is that going green doesn't mean giving up power. The

pilot shows that smart design and renewable energy can work together in the real world and still be good for business. CloudFerro, ELECT, and their partners' work shows how useful it can be to work together to make new technology that will last. This method can be used again in many areas. It can be used in hospitals, research centres, and systems that help people get back on their feet after a disaster. This setup could help the aerOS project move in a new, more realistic direction for greener digital systems if more people use it.

7.3. Joint Exploitation Plan for Pilot 3: High-Performance Computing Platform for Connected and Cooperative Mobile Machinery to Improve CO₂ Footprint (TTC and John Deere)

Pilot 3 is centered on transforming precision agriculture by using the aerOS edge-cloud framework and smart IoT technologies to make farming more efficient and environmentally friendly. Led by the John Deere European Technology Innovation Center, with support from TTControl, the project tackles long-standing challenges in modern farming, from uneven resource use and limited rural connectivity to the need for better coordination among agricultural machines.

By combining distributed computing, lightweight AI models, and real-time orchestration, the pilot demonstrates how technology can help farmers run operations that are smarter, scalable, and sustainable.

The pilot takes place in Kaiserslautern, Germany, and is built around two main use cases:

1. **Cooperative Large-Scale Harvesting:** improving field operations with fleets of fully electric, AI-guided swarm vehicles that can work together efficiently.
2. **CO₂-Neutral Smart Farming:** cutting energy use and emissions through fast, low-latency networks and edge computing that enable instant data analysis and decision-making.

This exploitation plan explains how John Deere, TTControl, and their partners are combining their expertise to expand the use of aerOS technologies in agriculture and related fields. The shared goal is to prove that high-tech farming can be both productive and sustainable.

Shared Vision Pilot 3 aims to reshape the way agricultural systems work by bringing real-time analytics, AI-based decision tools, and connected IoT devices directly into daily farming operations. The core objectives are:

- To optimize field coordination and ensure seamless teamwork between machines.
- To lower emissions and energy use with intelligent, efficient computing at the edge.
- To strengthen the role of John Deere, TTControl, and their partners as leaders in digital and sustainable agriculture.

Synergies Across Partners

The collaborative efforts between John Deere, TTControl, and external stakeholders enable a holistic approach to achieving the pilot's objectives. Below is Table 44 detailing the key synergies and outcomes:

Table 44 Pilot 3 Synergies and outcomes

	Synergies	Details
Real-Time Swarm Management	- John Deere develops prototype vehicles with embedded AI capabilities. - TTControl provides ECU platforms optimized for AI execution.	- Efficient coordination and synchronization of swarm vehicles, reducing energy consumption.
Predictive Maintenance	- John Deere supplies real-world operational data. - TTControl integrates predictive maintenance algorithms into edge systems.	- Proactive fault detection minimizes downtime and extends equipment lifespan.

Edge-Cloud Continuum	- TTControl develops real-time orchestration frameworks. - John Deere ensures seamless deployment in operational environments.	- Scalable and flexible IoT infrastructure for diverse farming applications.
Collaborative R&D	- Partners refine aerOS components to enhance functional safety and computational efficiency.	- Development of scalable, future-proof solutions applicable across multiple agricultural domains.

Objectives and Outcomes

Pilot 3 aims to redefine precision farming by addressing key challenges through the deployment of aerOS technologies. The main objectives and expected outcomes include:

Objectives

1. **Real-Time Swarm Management:** Optimize large-scale harvesting operations using distributed AI for task allocation and synchronization of cooperative machinery.
2. **CO₂ Emission Reduction:** Deploy edge computing and frugal AI models to minimize energy consumption during agricultural processes.
3. **Scalable IoT Architecture:** Develop a vendor-agnostic platform capable of integrating heterogeneous devices for seamless communication and data sharing.
4. **Functional Safety:** Ensure reliable and secure operations of autonomous machinery through high-performance computing platforms with built-in safety features.

Outcomes

- **Operational Efficiency:** Enhanced coordination of swarm vehicles reduces resource waste and maximizes productivity.
- **Environmental Impact:** Reduced CO₂ emissions align with sustainability goals and improve energy efficiency.
- **Scalability:** Modular IoT solutions allow for flexible adaptation to various farming scenarios, including large-scale and smallholder operations.
- **Technology Leadership:** Positioning John Deere and TTControl as industry leaders in digital agriculture and autonomous machinery.

7.3.1. Exploitation Plan – Before/After aerOS Implementation

Pilot 3 looks at how aerOS can actually change farming in practice. The aim is to make agriculture more connected, more efficient, and less harmful to the environment. Before aerOS came into play, farms struggled with scattered systems, machines didn't talk to each other, power use was high, and the lack of reliable networks made it hard to run advanced digital tools.

With aerOS now integrated, farms can use IoT sensors, edge computing, and lightweight AI to manage daily operations in smarter and greener ways. The pilot clearly shows how moving from disconnected setups to unified digital systems can make farming both productive and sustainable.

Before aerOS

Before the project started, farming technology had a few major pain points:

- **Systems didn't connect well:** Data came from different devices, but nothing was linked, so information couldn't be shared in real time.
- **High energy use:** Machines consumed a lot of power, raising costs and emissions.

- **Poor connectivity:** Rural areas often don't have stable networks, limiting digital adoption.
- **Hard to coordinate machinery:** Running several machines together required manual adjustments and constant supervision.

Technology Readiness Level (TRL):

- **Status:** TRL 4
- **What it meant:** The tech had been tested in small-scale trials but wasn't ready for wide use.
- **Key problem:** The lack of unified frameworks and energy-efficient design made it hard to expand or automate operations effectively.

After aerOS

After introducing aerOS, things began to work together much more smoothly:

- **Connected systems:** Devices and sensors now share information instantly, making field decisions faster and more accurate.
- **Smarter power use:** AI tools balance workloads and help cut unnecessary energy use, which directly reduces emissions.
- **Better connectivity:** Low-latency networks, including 5G, keep machines in sync across the farm.
- **Flexible setup:** The modular structure means small and large farms can both adapt the system easily.

Technology Readiness Level (TRL):

- **Status:** TRL 5
- **Details:** The updated system is being tested in real agricultural settings.
- **Result:** Faster data exchange, measurable energy savings, and higher reliability in field operations.

Benefits After Implementation

1. **Higher efficiency:** Better coordination and real-time insights reduce waste and machine downtime.
2. **Cleaner operations:** Energy use and CO₂ emissions drop noticeably.
3. **Scalability:** Works across different systems and brands, farmers aren't locked into one vendor.
4. **Safety and reliability:** Smarter control units and built-in safeguards make autonomous operations dependable.

Key Technological Advances

Distributed Computing Instead of sending everything to the cloud, data is processed closer to the machines. This makes response times almost instant, useful when conditions like soil moisture or weather shift quickly.

Decentralized Intelligence Lightweight "Frugal AI" models coordinate multiple machines so they work together efficiently without heavy computing demands. This saves both energy and bandwidth.

Real-Time Coordination aerOS keeps all connected devices under a single system. Data moves freely between edge and cloud, balancing workloads and keeping everything responsive.

Cybersecurity All information transfers are secured and monitored. The system protects against potential breaches and keeps operations running even if a network problem occurs.

High-Performance Platform The pilot's hardware platform combines sensors, control units, and AI software to automate tasks like row detection and soil management safely and accurately.

Results in Practice

The pilot shows real, measurable results:

- **Energy savings** from local data processing.
- **Fewer emissions** through better task scheduling and electric equipment.
- **Higher uptime** thanks to predictive maintenance and data-based monitoring.
- **Easier scaling** to larger or smaller farms without new infrastructure.

Challenges and Opportunities

Current Challenges:

- Different IoT devices still use incompatible standards.
- Rural areas have limited connectivity.
- Upfront costs can be a barrier for smaller farms.
- Concerns remain about data privacy.
- Some users are skeptical about new digital systems.

Opportunities Ahead:

- Demand for eco-friendly farming keeps growing.
- Wider 5G coverage improves real-time coordination.
- Precision agriculture is becoming mainstream.
- aerOS's open design works with all kinds of equipment.
- Cooperative swarm vehicles could reshape large-scale harvesting.

Summary

Pilot 3 proves that smart farming doesn't have to be complex or costly. By linking data, machines, and renewable energy through aerOS, farms can boost productivity, cut emissions, and manage resources better. It's not just about technology it's about giving agriculture practical tools to work smarter, cleaner, and more sustainably for the long run.

7.3.2. Lean Canvas

Pilot 3 focuses on revolutionizing agriculture through the deployment of aerOS-enabled technologies in connected and cooperative mobile machinery. By addressing challenges like energy inefficiency, fragmented IoT systems, and connectivity gaps, this pilot aims to optimize farming processes, improve CO₂ footprints, and enhance operational efficiency. The following Lean Canvas (Table 45) outlines the core components of the pilot's business strategy.

High-Performance Computing Platform for Connected and Cooperative Mobile Machinery to Improve CO₂ Footprint

Problem	Solution	Value Proposition	Early Adopters	Customer Segments
- Fragmented IoT ecosystems prevent seamless data sharing and decision-making. - High energy consumption contributes to environmental degradation and operational costs. - Limited network availability in rural areas disrupts real-time communication and data processing. - Synchronizing multiple machines is challenging without robust IoT and edge-cloud solutions.	- Integrated IoT Ecosystem - Energy Optimization - Enhanced Connectivity - Scalable Edge-Cloud Continuum	Pilot 3 offers an innovative, eco-friendly, and scalable solution for precision farming: Eco-Efficiency: Real-time embedded analytics reduce energy use and CO₂ emissions. Precision Farming: Synchronization and optimization of machinery improve productivity and reduce resource waste. Future-Ready Platform: Vendor-agnostic and modular design supports integration with diverse farming equipment.	- Innovative farming operations and agricultural enterprises piloting connected machinery. - OEMs developing autonomous mobile equipment.	Primary Customers: - Large-scale agricultural enterprises seeking to modernize operations. - Off-highway Original Equipment Manufacturers (OEMs). Secondary Customers: - Small and medium-sized farms looking to adopt sustainable practices. - Technology providers for agricultural machinery.
Key Metrics		Channels		
- Efficiency Gains - CO₂ Reduction - Operational Uptime - Scalability		- Existing sales networks of John Deere and TTControl. - Agricultural expos and technology fairs showcasing precision farming solutions. - Targeted outreach to enterprise customers and OEMs.		
Cost Structure		Revenue Streams		
High Development Costs: Investment in AI model development, edge computing infrastructure, and system integration. Unit Costs: Hardware production for edge devices and sensors. R&D Expenditure: Ongoing research to refine AI and IoT capabilities.		Hardware Sales: Sale of IoT devices and edge computing hardware. Licensing: Proprietary software for predictive maintenance and cooperative machinery coordination. Consulting and Training Services: Offering expertise on implementing aerOS solutions in agricultural operations.		

Figure 55 Pilot 3's Business Model Canvas

Table 45 Pilot3 LeanCanvas

Category	Details
Problem	Fragmented IoT ecosystems prevent seamless data sharing and decision-making. High energy consumption contributes to environmental degradation and operational costs. Limited network availability in rural areas disrupts real-time communication and data processing. Synchronizing multiple machines is challenging without robust IoT and edge-cloud solutions.
Solution	Integrated IoT Ecosystem: Establish seamless communication between IoT sensors, edge devices, and cloud systems. Energy Optimization: Use Frugal AI models to dynamically manage energy consumption and reduce CO₂ emissions. Enhanced Connectivity: Leverage 5G and low-latency networks for real-time synchronization of cooperative machinery. Scalable Edge-Cloud Continuum: Enable modular and vendor-agnostic solutions adaptable to farms of all sizes.
Unique Value Proposition	Pilot 3 offers an innovative, eco-friendly, and scalable solution for precision farming. Eco-Efficiency: Real-time embedded analytics reduce energy use and CO₂ emissions. Precision Farming: Synchronization and optimization of machinery improve productivity and reduce resource waste. Future-Ready Platform: Vendor-agnostic and modular design supports integration with diverse farming equipment.
Customer Segments	Primary Customers: Large-scale agricultural enterprises seeking to modernize operations.

	Off-highway Original Equipment Manufacturers (OEMs). Secondary Customers: Small and medium-sized farms looking to adopt sustainable practices. Technology providers for agricultural machinery.
Early Adopters	Innovative farming operations and agricultural enterprises piloting connected machinery. OEMs developing autonomous mobile equipment.
Channels	Existing sales networks of John Deere and TTControl. Agricultural expos and technology fairs showcasing precision farming solutions. Targeted outreach to enterprise customers and OEMs.
Key Metrics	Efficiency Gains: 30% improvement in energy efficiency through optimized machinery operation. CO₂ Reduction: Significant reduction in greenhouse gas emissions from farming activities. Operational Uptime: 20% reduction in equipment downtime via predictive maintenance. Scalability: Demonstrated adaptability across diverse farming operations and machinery types.
Cost Structure	High Development Costs: Investment in AI model development, edge computing infrastructure, and system integration. Unit Costs: Hardware production for edge devices and sensors. R&D Expenditure: Ongoing research to refine AI and IoT capabilities.
Revenue Streams	Hardware Sales: Sale of IoT devices and edge computing hardware. Licensing: Proprietary software for predictive maintenance and cooperative machinery coordination. Consulting and Training Services: Offering expertise on implementing aerOS solutions in agricultural operations.

Pilot 3's Lean Canvas demonstrates its potential to disrupt traditional farming practices by introducing scalable, sustainable, and technologically advanced solutions. By addressing critical industry challenges and leveraging emerging opportunities, the pilot establishes a roadmap for modernizing agriculture and reducing its environmental footprint.

7.3.3. SWOT Analysis

The Pilot 3 aims to revolutionize agriculture by leveraging aerOS-enabled technologies to improve operational efficiency, reduce CO₂ footprints, and promote sustainable farming practices.

This SWOT analysis (Table 46) provides a comprehensive evaluation of the strengths, weaknesses, opportunities, and threats associated with the pilot, offering insights into its strategic position and potential for success.

Pilot 3 SWOT Analysis Diagram

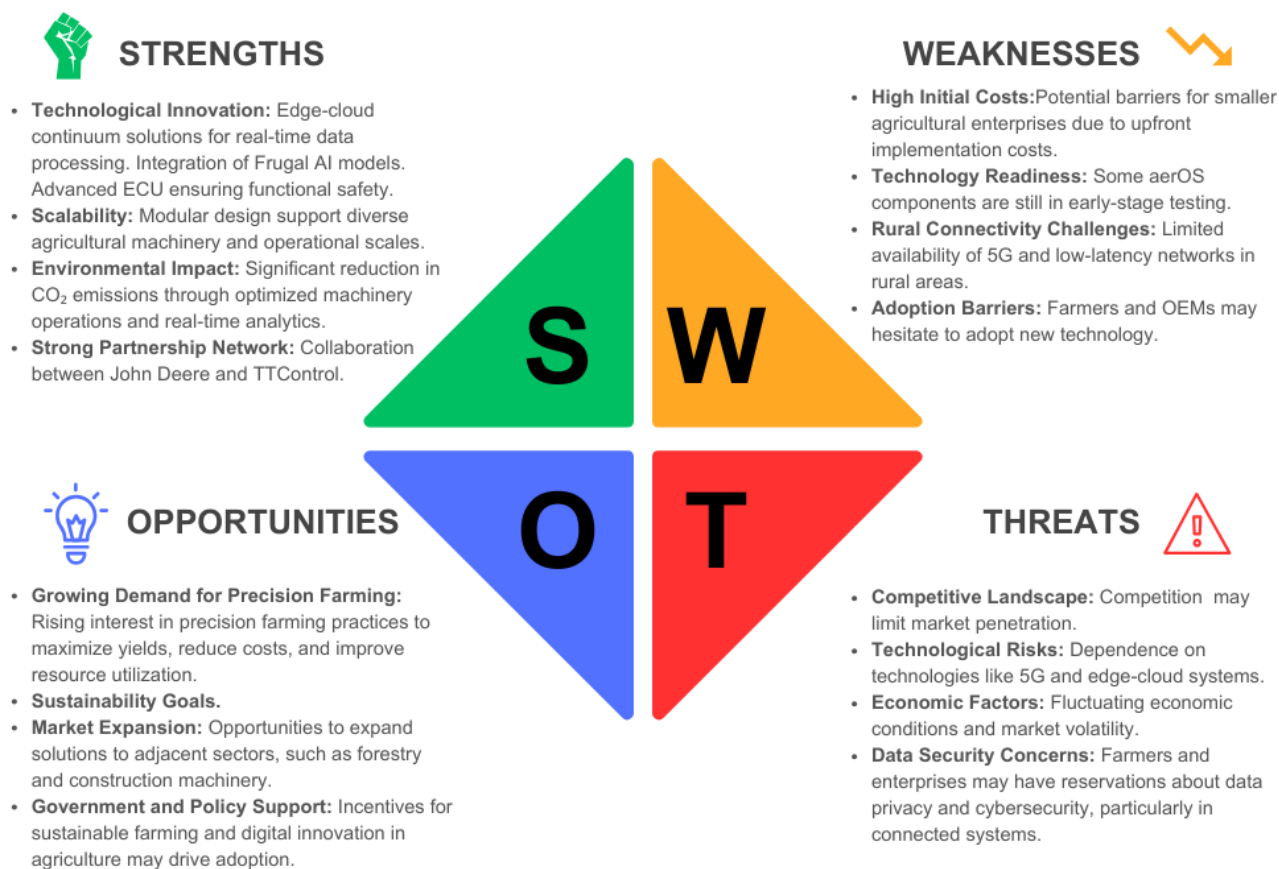


Figure 56 Pilot 3's SWOT Analysis

Table 46 Pilot3 SWOT Analysis

Category	Details
Strengths	Technological Innovation: Deployment of cutting-edge edge-cloud continuum solutions for real-time data processing. Integration of Frugal AI models for energy optimization and predictive maintenance. Advanced ECU platforms ensuring functional safety and reliable operations. Scalability: Modular and vendor-agnostic design supports diverse agricultural machinery and operational scales. Ability to adapt solutions to small farms and large-scale agricultural enterprises. Environmental Impact: Significant reduction in CO₂ emissions through optimized machinery operations and real-time analytics. Alignment with global sustainability goals and eco-friendly practices. Strong Partnership Network: Collaboration between John Deere and TTControl, combining expertise in agricultural machinery and IoT systems. Access to advanced research and development capabilities from the European Technology Innovation Center.
Weaknesses	High Initial Costs: Significant investment required for hardware development, software integration, and R&D efforts. Potential barriers for smaller agricultural enterprises due to upfront implementation costs.

	Technology Readiness: Some aerOS components are still in early-stage testing (e.g., real-time embedded analytics and self-realtimeness components). Compatibility issues between aerOS components and existing ECU platforms may require further development. Rural Connectivity Challenges: Limited availability of 5G and low-latency networks in rural areas may impact the performance of edge-cloud systems. Adoption Barriers: Farmers and OEMs may hesitate to adopt new technology due to unfamiliarity or perceived complexity.
Opportunities	Growing Demand for Precision Farming: Rising interest in precision farming practices to maximize yields, reduce costs, and improve resource utilization. Potential for widespread adoption as agricultural enterprises seek digital transformation. Sustainability Goals: Increasing global emphasis on reducing agricultural emissions and promoting eco-friendly practices aligns with Pilot 3's objectives. Market Expansion: Opportunities to expand solutions to adjacent sectors, such as forestry and construction machinery. Potential for global adoption, especially in regions with large-scale agricultural operations. Government and Policy Support: Incentives for sustainable farming and digital innovation in agriculture may drive adoption. Alignment with EU policies on sustainability and agricultural modernization.
Threats	Competitive Landscape: Competition from existing IoT and precision farming solutions may limit market penetration. Proprietary systems from competitors may challenge aerOS's vendor-agnostic positioning. Technological Risks: Dependence on emerging technologies like 5G and edge-cloud systems introduces risks related to network reliability and performance. Economic Factors: Fluctuating economic conditions and market volatility may impact farmers' willingness to invest in advanced technologies. Data Security Concerns: Farmers and enterprises may have reservations about data privacy and cybersecurity, particularly in connected systems.

The SWOT analysis highlights Pilot 3's potential to transform the agricultural sector through innovative, sustainable, and scalable solutions. While the pilot boasts significant strengths and opportunities, addressing weaknesses such as high costs and rural connectivity challenges will be crucial. By mitigating threats and leveraging its unique value propositions, Pilot 3 is well-positioned to redefine farming practices and contribute to a more sustainable future.

7.3.4. Llava Matrix

The Llava Matrix (Table 47) is a structured framework designed to align user needs, business models, and innovation strategies for effective exploitation of results. For Pilot 3, the matrix describes how the aerOS-enabled High Performance Computing Platform can address agricultural challenges, incorporate partner synergies, and deliver measurable benefits to stakeholders. By integrating user experiences and iterative innovation processes, the Llava Matrix ensures that solutions are not only technologically viable but also economically viable and user-friendly.

Table 47 Pilot3 Llava Matrix

Customer Segment	Common Need	Value Proposition	Solution	Value Network	Competition	Willingness to Pay
Agricultural Enterprises	Optimize farming processes and reduce CO ₂ footprint.	Real-time IoT and AI-driven automation for farming operations.	Deploy a high-performance computing platform integrating edge-cloud continuum and Frugal AI models.	Collaboration between John Deere (machinery expertise) and TTControl (IoT and ECU integration).	Competing IoT platforms offering limited scalability and vendor-locked solutions.	High willingness to pay due to cost savings and sustainability benefits.
Equipment Manufacturers	Enhance machinery performance with integrated IoT capabilities.	Scalable, vendor-agnostic IoT solutions to improve operational efficiency.	Offer modular, standardized IoT frameworks that integrate seamlessly with existing equipment.	Partner with IoT vendors, AI developers, and John Deere to enhance interoperability.	Existing proprietary solutions with limited flexibility.	Moderate willingness to pay, driven by the need for differentiation.
Government/Policymakers	Reduce environmental impact of agricultural practices.	Support sustainable farming through CO ₂ reduction and resource efficiency.	Showcase Pilot 3 as a model for meeting EU sustainability goals and promoting eco-friendly agriculture.	Collaboration with policymakers to align solutions with sustainability incentives and programs.	Limited direct competition; alternative approaches may lack scalability.	High willingness to adopt due to alignment with environmental goals.
SMEs and Startups in Agritech	Access to advanced tools for precision farming without heavy capital investment.	Provide affordable, modular IoT platforms and AI applications for smaller agricultural setups.	Offer entry-level solutions leveraging Frugal AI and aerOS's scalable architecture.	Partner with innovation hubs and funding agencies to lower entry barriers for SMEs and startups.	Niche competitors targeting SMEs with simplified solutions.	High willingness to pay for cost-effective and scalable options.
End-Users (Farmers)	Improve crop yield, reduce costs, and ensure	AI-driven predictive maintenance and optimized resource	Deploy edge-enabled IoT systems for real-time monitoring	Integrate feedback loops between farmers, equipment	Competitors lack the ability to provide reliable solutions in	High willingness to pay for operational reliability and

	operational reliability.	management for farming machinery.	and control, even in low-connectivity rural areas.	manufacturers, and aerOS developers for continuous improvements.	low-connectivity environments.	efficiency gains.
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The Llava Matrix for Pilot 3 illustrates the alignment of technological innovations, user needs and business models. Addressing the challenges of precision agriculture and sustainability, the board highlights the potential of Pilot Program 3 to redefine agricultural practices through scalable, efficient and environmentally friendly solutions. The collaborative approach between partners ensures continuous innovation and long-term value creation for all stakeholders..

7.3.5. Porter's Five Forces Analysis

The Pilot 3 introduces an advanced IoT-enabled High-Performance Computing Platform to transform agricultural operations through precision farming, edge computing, and Frugal AI. By evaluating the competitive dynamics of the agricultural technology market, this Porter's Five Forces analysis (Table 49) explores the industry environment and the strategic positioning of aerOS-enabled solutions.

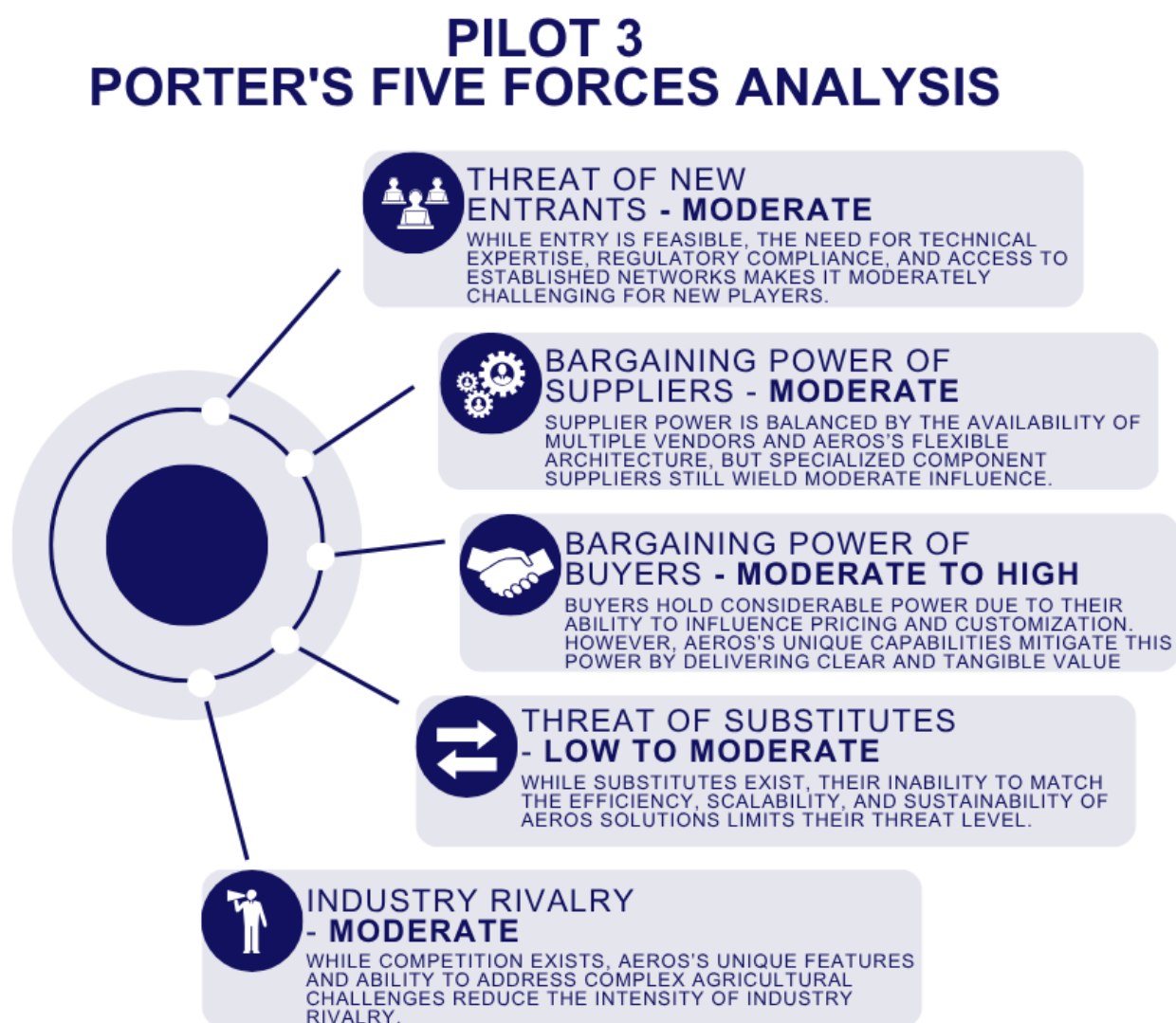


Figure 57 Pilot 3's Porter's Five Forces Analysis

Table 48 Pilot3 Porter's Five Forces Analysis

Force	Details
Threat of New Entrants (Moderate)	Barriers to Entry: Developing high-performance IoT platforms with integrated AI capabilities requires significant R&D investments and expertise in both agriculture and edge computing, creating a moderate barrier to entry. AerOS's vendor-agnostic and scalable architecture offers a competitive edge that new entrants would find challenging to replicate. Opportunities for New Entrants: The growing market for precision farming and sustainability-focused solutions creates opportunities for startups or established players in adjacent industries to enter the market. Analysis: While entry is feasible, the need for technical expertise, regulatory compliance, and access to established networks makes it moderately challenging for new players.
Bargaining Power of Suppliers (Moderate)	Factors Increasing Supplier Power: Suppliers of specialized IoT sensors, AI components, and edge computing hardware hold leverage due to the critical nature of their inputs. Limited providers for certain high-performance components, such as GPUs and low-latency communication devices, may further increase supplier power. Factors Reducing Supplier Power: The modular and vendor-agnostic nature of aerOS reduces dependency on any single supplier, allowing flexibility in sourcing. Analysis: Supplier power is balanced by the availability of multiple vendors and aerOS's flexible architecture, but specialized component suppliers still wield moderate influence.
Bargaining Power of Buyers (Moderate to High)	Factors Increasing Buyer Power: Agricultural enterprises and equipment manufacturers may demand customized solutions, giving them leverage in negotiations. With few competitors offering comparable functionality, large-scale buyers could demand favorable terms. Factors Reducing Buyer Power: AerOS's unique features, such as Frugal AI and edge-cloud continuum integration, provide a differentiated value proposition that reduces buyers' ability to negotiate. Analysis: Buyers hold considerable power due to their ability to influence pricing and customization. However, aerOS's unique capabilities mitigate this power by delivering clear and tangible value.
Threat of Substitutes (Low to Moderate)	Potential Substitutes: Traditional farming practices and legacy systems that rely on manual operations and non-IoT-enabled machinery. Competing IoT platforms with limited scalability and functionality could serve as partial substitutes. Limitations of Substitutes: Substitutes lack the real-time data processing, predictive maintenance, and vendor-agnostic capabilities offered by aerOS. Sustainability and CO₂ reduction goals are difficult to achieve with traditional methods or less advanced systems. Analysis: While substitutes exist, their inability to match the efficiency, scalability, and sustainability of aerOS solutions limits their threat level.
Industry Rivalry (Moderate)	Competitive Landscape: The market for precision farming and IoT-enabled agriculture is growing, attracting both established players and innovative startups. Existing competitors may offer partial solutions but often lack the fully integrated capabilities of aerOS. Differentiation: AerOS sets itself apart through its vendor-agnostic design, Frugal AI models, and modular architecture, reducing direct head-to-head competition. Analysis: While competition exists, aerOS's unique features and ability to address complex agricultural challenges reduce the intensity of industry rivalry.

7.3.6. Conclusion

Pilot 3 has shown in practical terms how aerOS can change the way farming is planned and managed. By linking IoT devices, edge computing, and lightweight AI, the team managed to solve long-standing problems like disconnected systems, high energy use, and the difficulty of coordinating multiple machines in the field.

With the introduction of a high-performance computing platform, data is now processed right where it is collected. Farmers and operators can act on information immediately, improving accuracy and response times. This approach has led to better efficiency, lower running costs, and a visible drop in CO₂ emissions.

The partnership between John Deere, TTControl, and the wider project group also highlighted the importance of open, flexible systems that can work across different types of equipment and farm sizes. The experience gained here lays the foundation for future progress in predictive maintenance, smarter AI tools, and advanced automation.

In essence, Pilot 3 points the way toward a new model of farming—one that brings digital technology and sustainability together. It proves that agriculture can stay productive while also protecting the environment, setting a strong example for how the sector can evolve in the years ahead.

7.4. Joint Exploitation Plan for Pilot 4: Smart Edge Services for the Port Continuum (ECTL, CUT and PRO)

Pilot 4 Pilot 4, titled *Smart Edge Services for the Port Continuum*, takes place at the EUROGATE Container Terminal Limassol (ECTL), Cyprus's only container terminal and the main gateway for over 90% of the island's cargo traffic. Supported by ProDevelop (PRO) and the Cyprus University of Technology (CUT), this pilot focuses on modernizing port operations through the integration of aerOS-enabled technologies such as predictive maintenance and computer vision (CV).

ECTL is already advancing its digital transformation journey, and aerOS now serves as the foundation for building a scalable IoT infrastructure. Over the coming five years, the terminal plans to connect more than 200 devices, paving the way for a new level of automation and operational intelligence.

The pilot concentrates on two main application areas:

1. **Predictive Maintenance of Container Handling Equipment**
2. **Risk Prevention through Edge-Enabled Computer Vision**

Infrastructure and Technology

The terminal operates 36 Straddle Carriers (SCs), 4 Ship-to-Shore (STS) Cranes, and a range of other container handling assets. A selection of this equipment forms part of an aerOS ecosystem, integrating various Infrastructure Elements (IEs) that operate within a 10T Edge-Cloud continuum.

Use Case Scenarios

- **Predictive Maintenance** STS cranes and SCs within the ECTL domain collect sensor data and perform initial processing via Programmable Logic Controllers (PLCs). This data is then managed by high-end Infrastructure Elements that coordinate distribution and analytics services through aerOS.
- **Risk Prevention through Computer Vision** Within the CUT domain, the focus is on processing video feeds from the terminal's CCTV network. Machine Learning (ML) models are trained to detect and analyze container damage automatically, reducing manual inspection times and improving accuracy.

Shared Vision

The goal of Pilot 4 is to create a smart, connected framework for port operations that merges edge-cloud computing, IoT, and AI analytics into daily workflows. This approach aims to:

- **Increase Operational Efficiency:** Predictive maintenance helps reduce downtime and ensures equipment runs at optimal capacity.
- **Improve Safety and Accuracy:** Computer vision automates container inspection and enhances workplace safety.
- **Accelerate Digital Transformation:** Scalable IoT infrastructure supports ongoing port modernization and data-driven decision-making.
- **Strengthen Industry Leadership:** Establish ECTL and its partners as early adopters and leaders in next-generation port operations.

Synergies Across Partners

Pilot 4 thrives on the collaboration between ECTL, CUT, and ProDevelop, with each partner contributing distinct strengths. ECTL provides the industrial testbed and operational expertise; CUT leads on AI and CV development; and ProDevelop brings advanced IoT and data management capabilities. Together, they are setting the foundation for a smarter, safer, and more efficient port environment Table 49:

Table 49 Pilot 4 Synergies Across Partners

Key Area	Synergies	Outcome
Predictive Maintenance Integration	- ETL provides the real-world operational data from its assets. - CUT and ProDevelop develops Frugal AI models. - ProDevelop ensures system integration.	- Reduced equipment downtime and improved maintenance scheduling.
Computer Vision Deployment	- CUT develops advanced CV models. - ETL provides the footage to develop and validate solutions in live port environments. - ProDevelop integrates CV tools.	- Automated damage and seal checks enhance customer satisfaction and safety.
IoT Infrastructure Implementation	- ECTL infrastructure serves as a testing ground. - ProDevelop deploys scalable, vendor-agnostic IoT solutions.	- Robust IoT infrastructure supports ongoing digitization and scalability for other port terminals.
Collaborative R&D	- Partners jointly optimize aerOS deployment and examine new use cases going forward.	- Development of enhanced models and solutions applicable across the EU port terminal landscape.

Pilot 4 looks at how ports can run smarter and more efficiently by mixing IoT technology with artificial intelligence. The main goal is simple: make the terminal safer, faster, and easier to manage. By digitizing key equipment, predicting maintenance needs, and adding computer vision tools for container checks, the project is showing how modern tech can bring real change to daily port operations.

The setup is built around a flexible IoT system that links small sensors with stronger edge servers. This mix allows data to flow smoothly while keeping everything adaptable as the port grows or brings in new technology later on.

Key Objectives

1. **Digitize Port Equipment** Build an IoT platform that lets teams see what's happening with every major asset in real time. This kind of visibility makes it easier to plan, react quickly to problems, and keep operations running more smoothly.

2. **Predictive Maintenance** Use light, efficient AI models to spot early warning signs before machines break down. Instead of reacting to problems, the goal is to fix things before they stop working, saving time, money, and effort in the long run.
3. **Computer Vision Tools** Apply visual inspection systems to automate tasks like detecting container damage or checking seals. This takes pressure off manual inspection teams, improves accuracy, and helps reduce safety risks on the ground.
4. **Scalable IoT Setup** Design an IoT structure that can handle change, from a handful of sensors to hundreds of devices, without needing a full rebuild. It's meant to grow with the port and support future upgrades.

Expected Outcomes

- **More Efficient Operations** Equipment runs longer and with fewer interruptions, while maintenance becomes easier to plan. Overall, the terminal should see smoother workflows and lower running costs.
- **Improved Safety** Automating inspection and monitoring means fewer people exposed to heavy machinery or risky areas. That directly translates into fewer accidents and safer conditions for workers.
- **Better Service Quality** Accurate and faster container checks mean fewer disputes and delays, leading to happier clients and stronger trust in port services.

7.4.1. Exploitation Plan – Before/After aerOS Implementation

T Pilot 4 has shown in a very direct way how the aerOS platform can reshape daily work at the EUROGATE Container Terminal in Limassol. The technology helped tackle long-standing problems that slowed down operations, mostly the lack of system integration and limited visibility over port activities. Since deploying aerOS, the terminal has moved toward a more connected, data-driven model that makes equipment safer, more reliable, and easier to manage.

Before aerOS came in, the terminal's systems were mostly separate from each other. Each machine, cranes, straddle carriers, and other handling units, worked in its own "bubble," with no shared data. Maintenance was carried out on a set schedule, regardless of the actual condition of the machines, which often led to unnecessary service stops or unexpected breakdowns. At the same time, container inspections relied heavily on manual checks, which could be slow, inconsistent, and sometimes risky. Although cameras were already installed around the port, their use was limited to simple monitoring rather than advanced image analysis or automation.

Before aerOS

Main Challenges

- No integrated IoT network connecting equipment or systems.
- Maintenance based on fixed time intervals instead of real condition data.
- Manual container inspections prone to human error.

Limitations

- No use of operational data for prediction or performance tracking.
- Systems worked in isolation, with no data sharing between them.
- Limited technical know-how in cloud and edge computing.
- Cameras underused, only for safety, not analytics.

Technology Readiness Level: TRL 2 – existing systems functional but not connected.

After aerOS

Once aerOS was implemented, ECTL gained an entirely new level of visibility and control. The terminal now has a scalable IoT infrastructure that ties all major equipment together. This means that data from cranes,

carriers, and sensors can be processed locally and used immediately for decision-making. The platform allows real-time communication between devices, from small IoT sensors to powerful edge servers, creating a true digital ecosystem.

Predictive maintenance is one of the biggest changes. Instead of relying on fixed service intervals, aerOS uses AI models to detect early signs of wear and alert engineers before issues occur. This shift not only prevents costly breakdowns but also extends the lifetime of key assets.

Another step forward came from computer vision. Automated systems now analyze camera feeds to spot damage or check seals on containers. That reduces the need for manual inspections, saves time, and improves accuracy. It also makes the work environment safer by keeping staff away from high-risk areas.

Transformations

- A full IoT network now connects all port assets.
- Predictive maintenance cuts downtime and boosts reliability.
- AI-based inspection improves accuracy and consistency.
- Customer disputes about container damage are less frequent.

Technology Readiness Level: TRL 5 – tested and validated in operational conditions.

Key Technological Innovations

Distributed Computing In the past, all operational data had to be sent to central servers for analysis, which slowed things down. With aerOS, most processing happens right where the data is created, at the edge. This speeds up decisions, reduces network load, and lowers communication costs. In a busy port, that speed matters: issues are identified faster, and responses can happen almost in real time.

Interoperability Between Systems Port terminals use equipment from many manufacturers, each with its own format. aerOS solves that problem by standardizing how data is shared, so all systems can talk to each other. This removes silos and makes it easier to scale the setup as new machines or sensors are added.

Simple Integration Tools Adding new IoT devices can be complicated. aerOS includes straightforward APIs that let staff configure or update systems without deep programming skills. This helps speed up adoption and reduces the need for external support.

Together, these elements give ECTL a connected, flexible system that can grow and adapt as technology and operational needs evolve.

Measuring Success

The impact of aerOS at the terminal is being tracked using a few practical indicators that show how the technology improves reliability, precision, and scalability.

- **Equipment Uptime** With predictive maintenance in place, unplanned downtime should drop sharply. The goal is to keep equipment available more often, ideally boosting uptime by about 20%.
- **Inspection Accuracy** AI-based image analysis improves the consistency of container inspections. Accuracy is expected to rise by around 60%, cutting down on errors and customer complaints.
- **Expansion and Adoption** The success of ECTL's pilot sets an example for other ports. Within three years, the aim is for at least one or two additional terminals to adopt aerOS-based systems.

Market

Port terminals are complex environments, and operators are naturally cautious about adopting new digital systems. Reliability is everything; if something stops working, operations grind to a halt. That said, the maritime industry is moving steadily toward more data-driven methods, and solutions like aerOS are arriving at the right time.

Key Challenges

- Building trust in new systems that replace long-established procedures.
- Integrating technology across diverse equipment and legacy systems.

- Ensuring strong cybersecurity in connected environments.

Emerging Opportunities

- Strong industry momentum toward digital transformation and automation.
- Demand for vendor-neutral platforms that can integrate multiple systems.
- aerOS's built-in security and flexible design make it a credible long-term option.

Looking Ahead

After the success of Pilot 4, the next step is to expand what has already been achieved.

- Predictive maintenance tools can be extended to cover more types of machinery and sensors.
- A vendor-agnostic IoT platform will be developed to support uniform data management across different terminals.
- The experience from Limassol can serve as a reference model for European and international ports moving toward digital transformation.

Partnerships between ECTL, CUT, and ProDevelop will continue, focusing on joint development, real-world trials, and scaling aerOS solutions for global use..

7.4.2. Lean Canvas

Pilot 4 aims to modernize how port terminals are managed by introducing aerOS technologies that combine predictive maintenance, computer vision (CV), and intelligent IoT systems. The pilot is carried out at the EUROGATE Container Terminal in Limassol (ECTL), with technical guidance from Prodevelop (PRO) and the Cyprus University of Technology (CUT). Its purpose is to solve key challenges in port operations—boosting efficiency, improving safety, and creating systems that can easily expand as activity grows. By blending IoT connectivity, artificial intelligence, and edge-cloud computing, the project showcases how smart, data-driven solutions can streamline workflows and make terminal operations more resilient and sustainable

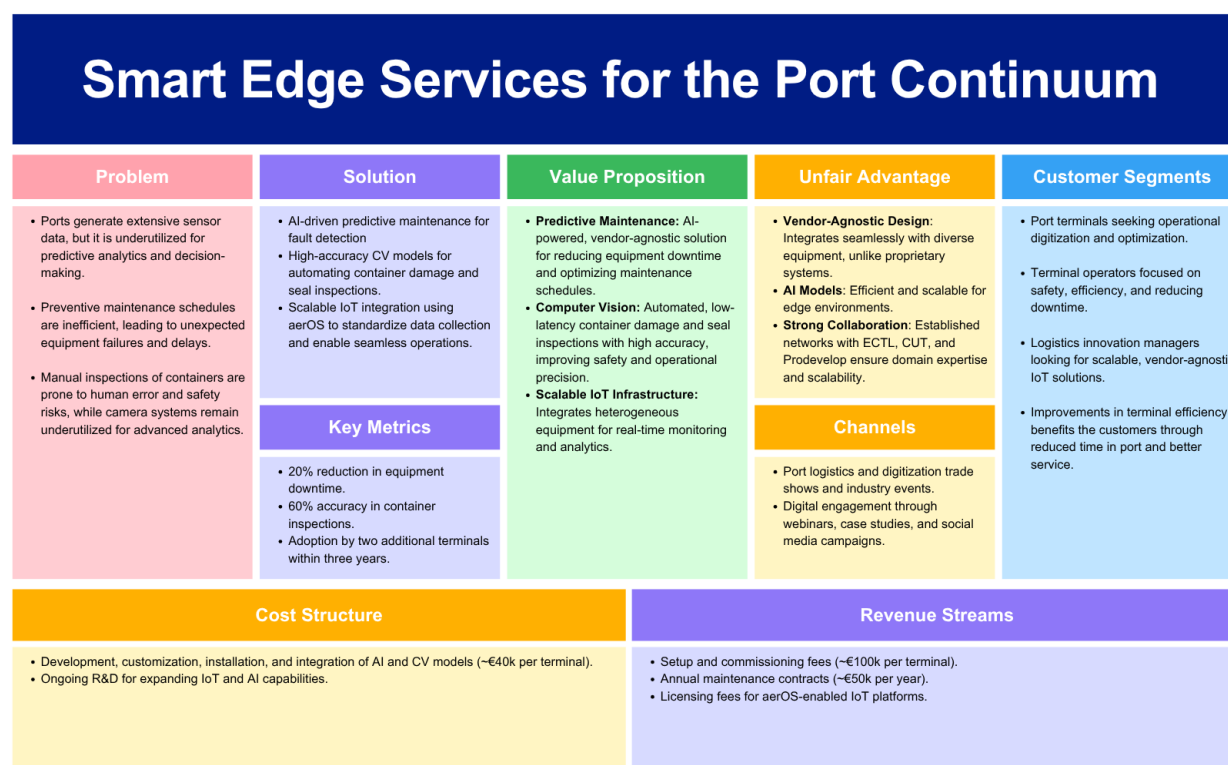


Figure 58 Pilot 4's Business Model Canvas

Table 50 Pilot 4 Lean Canvas

Category	Details
Problem	Ports generate extensive sensor data, but it is underutilized for predictive analytics and decision-making. Preventive maintenance schedules are inefficient, leading to unexpected equipment failures and delays. Manual inspections of containers are prone to human error and safety risks, while camera systems remain underutilized for advanced analytics.
Customer Segments	Port Terminals: Seeking operational digitization and optimization. Terminal Operators: Focused on safety, efficiency, and reducing downtime. Logistics Innovation Managers: Looking for scalable, vendor-agnostic IoT solutions. End Customers: Benefit from reduced time in port and better service through improved terminal efficiency.
Unique Value Proposition	Predictive Maintenance: AI-powered, vendor-agnostic solution for reducing equipment downtime and optimizing maintenance schedules. Computer Vision: Automated, low-latency container damage and seal inspections with high accuracy, improving safety and operational precision. Scalable IoT Infrastructure: Integrates heterogeneous equipment for real-time monitoring and analytics.
Solution	AI-Driven Predictive Maintenance: Fault detection using AI models to minimize unplanned downtime. Computer Vision Models: Automate container damage and seal inspections with high accuracy. Scalable IoT Integration: Uses aerOS to standardize data collection and enable seamless operations.
Channels	Port Logistics and Digitization Events: Trade shows and industry exhibitions. Digital Engagement: Webinars, case studies, and social media campaigns to reach potential clients.
Revenue Streams	Setup and Commissioning Fees: Approximately €100k per terminal. Annual Maintenance Contracts: Around €50k per year. Licensing Fees: For aerOS-enabled IoT platforms and predictive maintenance tools.
Cost Structure	Development and Integration: Customization, installation, and integration of AI and CV models (~€40k per terminal). Research and Development: Continuous investment to expand IoT and AI capabilities.
Key Metrics	Equipment Downtime Reduction: 20% improvement in uptime through predictive maintenance. Inspection Accuracy: Achieving 60% accuracy in automated container inspections. Adoption Growth: Expansion to two additional terminals within three years.
Unfair Advantage	Vendor-Agnostic Design: Seamless integration with diverse port equipment, unlike proprietary systems. AI Models: Efficient and scalable for real-time edge environments. Strong Collaboration: Partnerships with ECTL, CUT, and Prodevelop ensure domain expertise and scalability.

This Lean Model Canvas (Table 51) captures Pilot 4's strategy for transforming port terminal operations with aerOS-enabled predictive maintenance, computer vision, and IoT solutions. By addressing industry challenges and leveraging advanced technologies, the pilot ensures scalable, efficient, and safe operations for ECTL and beyond.

7.4.3. SWOT Analysis

The SWOT analysis (Table 51) of Pilot 4 evaluates its strengths, weaknesses, opportunities, and threats in implementing aerOS technologies for enhanced port operations. This analysis highlights the pilot's potential to enhance port efficiency while addressing key challenges and leveraging market opportunities.

Pilot 4 SWOT Analysis Diagram

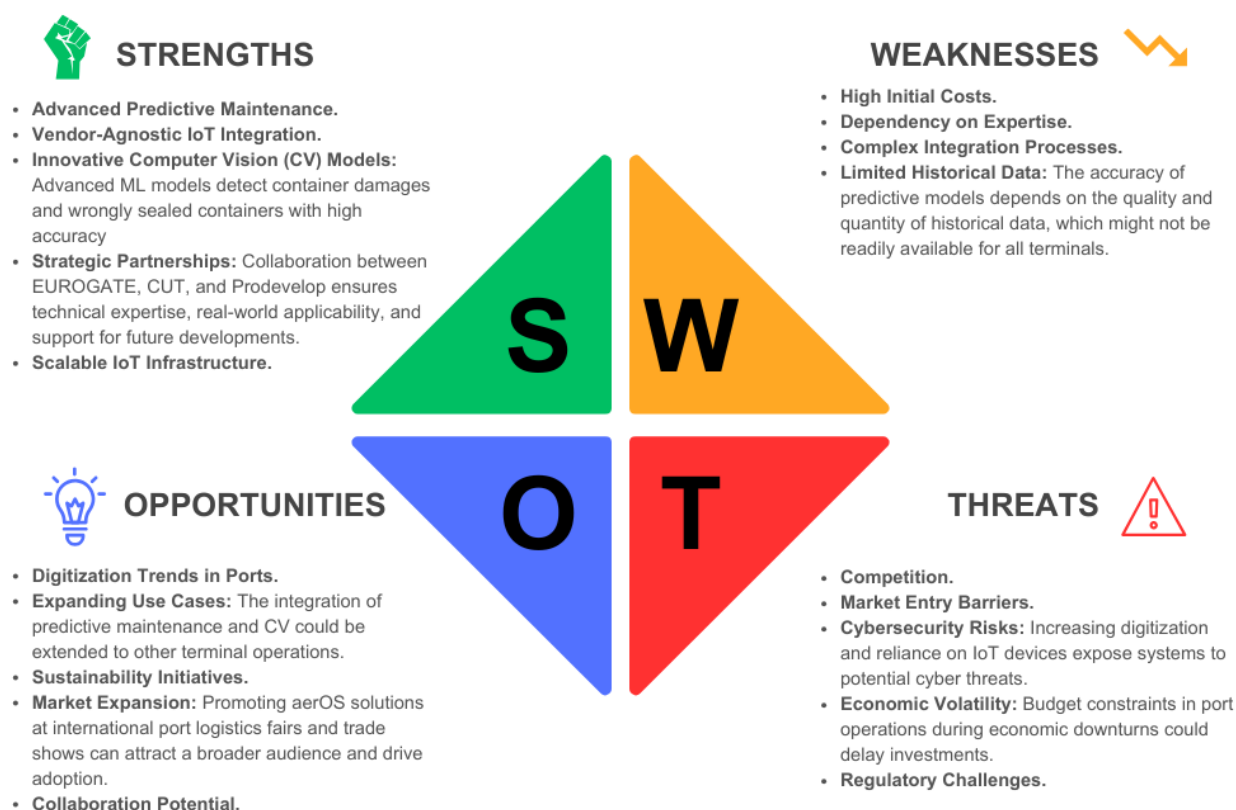


Figure 59 Pilot 4's SWOT Analysis

Table 51 Pilot4 SWOT Analysis

c	Column 2
Strengths	Advanced Predictive Maintenance: The use of AI models enhances operational efficiency by predicting failures and scheduling maintenance proactively, reducing unexpected downtimes. Vendor-Agnostic IoT Integration: aerOS provides a scalable and flexible framework compatible with heterogeneous Infrastructure Elements (IEs), supporting seamless integration of multiple vendors' devices. Innovative Computer Vision (CV) Models: Advanced ML models detect container damages and wrongly sealed containers with high accuracy, improving safety and reducing human errors.

	Strategic Partnerships: Collaboration between EUROGATE, CUT, and Prodevelop ensures technical expertise, real-world applicability, and support for ongoing and future developments. Scalable IoT Infrastructure: The aerOS architecture supports up to 200 devices within five years, demonstrating future-readiness and scalability.
Weaknesses	High Initial Costs: Implementation requires significant investment in infrastructure and personnel training, potentially limiting adoption for smaller terminals. Dependency on Expertise: Effective deployment relies on technical knowledge from maintenance staff and collaboration with equipment manufacturers for data access and interpretation. Complex Integration Processes: Integration with existing systems, especially for legacy equipment and diverse third-party assets, may face challenges. Limited Historical Data: The accuracy of predictive models depends on the quality and quantity of historical data, which might not be readily available for all terminals.
Opportunities	Digitization Trends in Ports: Growing interest in digitizing port operations creates a ripe market for aerOS-enabled solutions. Expanding Use Cases: The integration of predictive maintenance and CV could be extended to other terminal operations, such as inventory management and security. Sustainability Initiatives: Supporting green logistics through reduced machinery downtime and optimized maintenance aligns with global sustainability goals. Market Expansion: Promoting aerOS solutions at international port logistics fairs and trade shows can attract a broader audience and drive adoption. Collaboration Potential: Synergies between ECTL, Prodevelop, and CUT could lead to new innovations and service offerings in other industrial contexts.
Threats	Competition: Established proprietary solutions by large manufacturers pose a significant challenge, particularly in capturing market share. Market Entry Barriers: Trust issues in the closely-knit port terminal sector may slow the adoption of new solutions. Cybersecurity Risks: Increasing digitization and reliance on IoT devices expose systems to potential cyber threats. Economic Volatility: Budget constraints in port operations during economic downturns could delay investments in new technologies. Regulatory Challenges: Variations in local and international port regulations may impact the deployment and standardization of aerOS solutions.

This SWOT analysis highlights Pilot 4's potential to revolutionize port terminal operations through innovative IoT, AI, and CV technologies while addressing challenges related to integration, costs, and market trust. Strategic partnerships and growing interest in digitization offer significant opportunities for scaling and sustainability.

7.4.4. Llava Matrix

The Llava Matrix (Table 52) is structured to incorporate user needs, business models, and the innovation-driven approach of Pilot 4 into a collaborative framework. This matrix evaluates and aligns the core elements of the pilot with its exploitation potential, ensuring a robust and scalable impact on port terminal operations.

Table 52 Pilot4 Llava matrix

Category	Details
Customer Segment	Port Terminals and Logistics Operators: Port operators seeking to digitize and optimize their maintenance and inspection workflows. Logistics managers focused on enhancing efficiency, safety, and reducing operational downtime.
Common Need	Operational Efficiency: Minimize delays caused by equipment failures and manual inspections. Predictive Insights: Prevent unexpected breakdowns and reduce maintenance costs through predictive analytics. Automation: Leverage computer vision (CV) for accurate and automated container damage and seal inspections. Interoperability: Seamlessly integrate diverse equipment across heterogeneous systems.
Value Proposition	Predictive Maintenance: AI-driven fault detection reduces unplanned downtime and optimizes maintenance schedules. Computer Vision Automation: High-accuracy CV models eliminate human error, ensuring reliable and automated container inspections. Scalable IoT Platform: Vendor-agnostic, modular aerOS architecture supports integration of diverse assets for data-driven decision-making.
Solution	Edge Computing: Localized processing reduces latency and reliance on central cloud systems. AI Integration: Lightweight models ensure efficiency in resource-constrained environments. Standardized Protocols: Seamless data exchange across equipment from multiple vendors. User-Friendly APIs: Simplified system customization and rapid deployment for various operational contexts.
Value Network	Key Partners: ECTL (Eurogate) demonstrating operational improvements at a high-capacity terminal. Prodevelop expanding aerOS-based solutions to other EU terminals. CUT (Cyprus University of Technology) driving innovation in AI/ML and training future workforce for maritime informatics. Collaborative Opportunities: Extend partnerships with terminal operators and equipment manufacturers for broader market reach.
Competition	Existing Solutions: Proprietary predictive maintenance and OCR-based CV tools tailored to specific equipment vendors. Differentiators: aerOS's vendor-agnostic architecture, Frugal AI models optimized for edge devices, and scalability across diverse operational contexts.
Willingness to Pay	Initial Investment: Port terminals are willing to invest in IoT infrastructure that guarantees a measurable ROI in terms of operational efficiency and cost savings. Recurring Costs: Terminals will adopt subscription models for software updates, CV functionalities, and predictive maintenance services. Market Potential: High demand for solutions addressing port digitization and compliance with sustainability regulations.

The Llava Matrix for Pilot 4 aligns its innovations with the needs of port terminals, emphasizing scalability, efficiency, and safety. By addressing common challenges with tailored solutions and leveraging strategic

partnerships, Pilot 4 is well-positioned to drive long-term value and establish aerOS as a leader in smart port logistics.

7.4.5. Porter's Five Forces Analysis

The following analysis (Table 53) examines the competitive environment surrounding the deployment of aerOS-enabled technologies in port terminal operations, highlighting opportunities and challenges for Pilot 4's solutions.

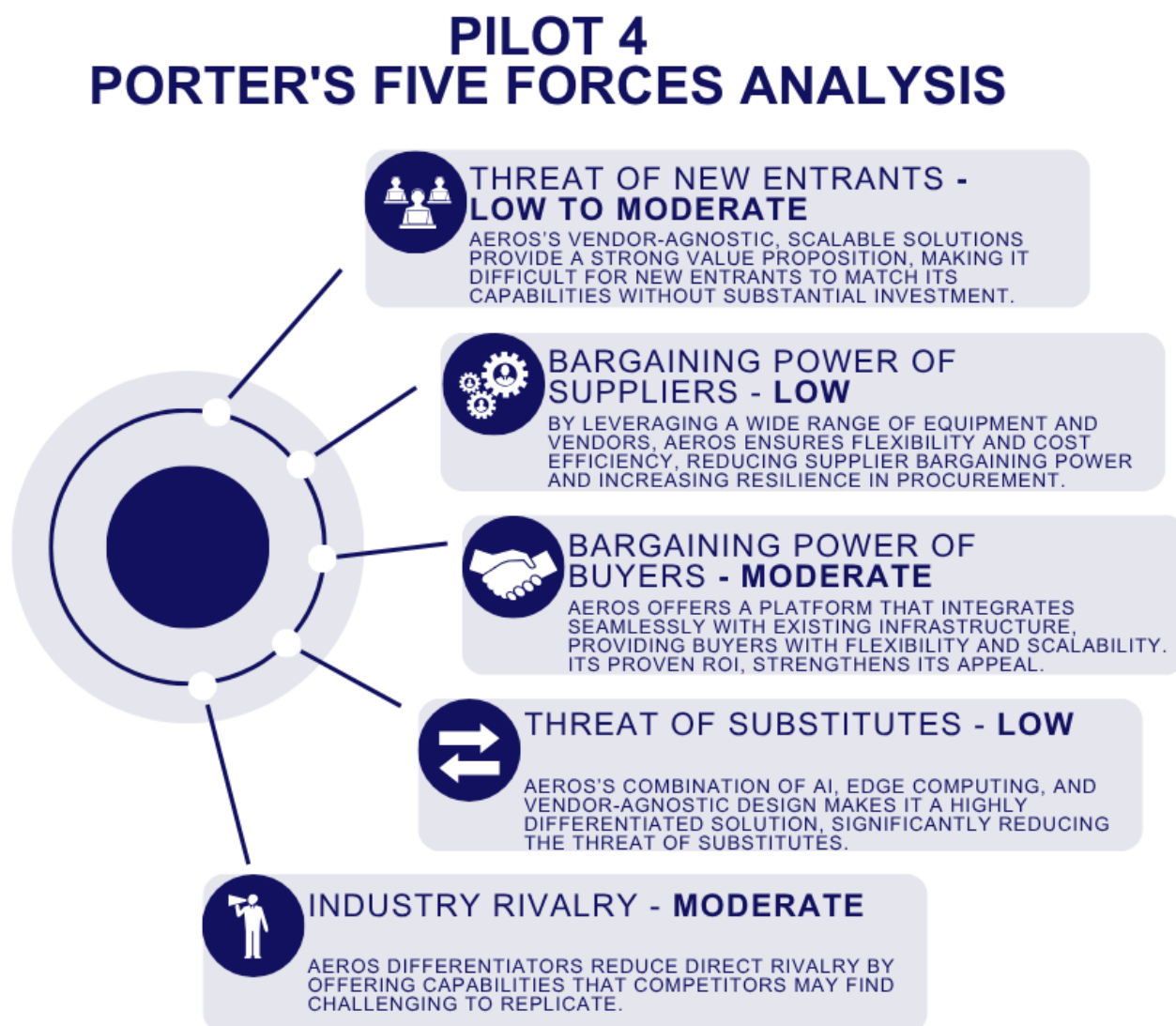


Figure 60 Pilot 4's Porter's Five Forces Analysis

Table 53 Pilot4 Porter's Five Forces Analysis

Category	Details
Threat of New Entrants (Low to Moderate)	Barriers to Entry: The port logistics sector requires significant expertise, resources, and established networks to deliver IoT and AI-driven solutions. Additionally, trust and reputation are critical, as ports are conservative environments that rely on proven, reliable systems. Pilot Advantage: aerOS's vendor-agnostic, scalable solutions provide a strong value proposition, making it difficult for new entrants to match its technological capabilities without substantial investment.

Bargaining Power of Suppliers (Low)	Supplier Dependency: The reliance on multiple technology providers, such as IoT gateways, sensors, and AI tools, reduces the dependency on any single supplier. Standardized protocols and interoperability further mitigate supplier power. Pilot Strategy: By leveraging a wide range of equipment and vendors, aerOS ensures flexibility and cost efficiency, reducing supplier bargaining power and increasing resilience in procurement.
Bargaining Power of Buyers (Moderate)	Buyer Dynamics: Port terminals are the primary buyers and tend to seek customized, high-value solutions to address specific operational challenges. While demand for digitization is growing, buyers often negotiate extensively for tailored systems and long-term cost savings. Pilot Advantage: aerOS offers a unique, vendor-agnostic platform that integrates seamlessly with existing infrastructure, providing buyers with flexibility and scalability. Its proven ROI, demonstrated by ECTL, strengthens its appeal and bargaining position.
Threat of Substitutes (Low)	Existing Alternatives: While some proprietary predictive maintenance and computer vision (CV) systems exist, they are often tied to specific vendors and lack the flexibility and scalability of aerOS. Most current camera systems focus on basic optical character recognition (OCR) rather than advanced CV analytics. Pilot Edge: aerOS's combination of AI, edge computing, and vendor-agnostic design makes it a highly differentiated solution, significantly reducing the threat of substitutes.
Industry Rivalry (Moderate)	Competitive Landscape: Established automation and IoT providers compete in the port logistics space, but their solutions are often proprietary and less adaptable. The growing emphasis on digitization has increased competition. Pilot Positioning: aerOS stands out due to its scalable, interoperable architecture and innovative features like predictive maintenance and advanced CV models. These differentiators reduce direct rivalry by offering capabilities that competitors may find challenging to replicate.

7.4.6. Conclusion

Pilot 4 highlights how aerOS can transform port logistics by integrating predictive maintenance and computer vision into everyday operations. Through the use of edge computing and IoT technologies, the pilot delivers clear improvements in efficiency, safety, and scalability. Close cooperation between ECTL, CUT, and ProDevelop has been key to its success, ensuring the technology fits real operational needs. More than just achieving immediate goals, the exploitation strategy places the partners at the leading edge of digital innovation in the port industry, paving the way for long-term growth and leadership in smart terminal operations.

7.5. Joint Exploitation Plan for Pilot 5: Energy-Efficient, Health-Safe, and Sustainable Smart Buildings (OTE, FOGUS, NCSRD, INF and UPV)

Pilot 5 explores how aerOS technologies can make enterprise buildings smarter, safer, and more sustainable. In partnership with COSM, NCSRD, FOGUS, INF, and UPV, the project combines IoT infrastructure, AI, and the aerOS edge-cloud system to improve energy efficiency and workplace well-being in a post-pandemic setting.

As office life shifts toward hybrid and flexible models, managing energy use and indoor comfort has become increasingly complex. Pilot 5 addresses these challenges by using aerOS's meta-operating system to create a scalable and vendor-neutral platform. It connects and manages a wide range of IoT devices, adapting automatically to occupancy, user preferences, and environmental conditions.

Key Partners

- **COSM:** Leads IoT integration and sensor deployment, hosting the pilot at OTE Academy.
- **NCSR:** Focuses on edge-cloud deployment and AI models for health and energy optimization.
- **FOGUS:** Develops the recommendation system based on aerOS's data fabric.
- **INF:** Builds the web application for smart workspace and seating recommendations.
- **UPV:** Contributes research on the aerOS meta-OS and explainable AI.

Main Outcomes

- 1. Energy Efficiency** Smart control of HVAC systems, smart plugs, and air-quality devices enables real-time energy optimization, reducing consumption and costs.
- 2. Health and Safety** AI-driven monitoring of CO₂, temperature, humidity, and motion ensures healthy indoor conditions. Real-time analytics recommend optimal workspace occupancy for safety and comfort.
- 3. Scalability** The modular, vendor-agnostic architecture allows seamless integration across different enterprise environments, supporting future expansion and innovation.

7.5.1. Exploitation Plan – Before/After aerOS Implementation

Before the deployment of **aerOS**, enterprise building management systems encountered numerous challenges and operational inefficiencies, primarily due to fragmented IoT infrastructures and outdated legacy technologies. The various IoT devices and subsystems in use were unable to communicate effectively, resulting in poor data utilization and disjointed management processes.

Conventional HVAC and lighting systems lacked the ability to adjust automatically to occupancy patterns or environmental conditions, leading to unnecessary energy consumption and operational waste. Moreover, traditional office configurations were ill-suited to meet modern workplace standards, particularly in maintaining healthy indoor air quality and supporting post-pandemic requirements such as social distancing and environmental monitoring.

Efforts to merge technologies from multiple IoT vendors were both time-consuming and resource-heavy, making large-scale integration difficult. The lack of real-time analytics and AI-supported recommendations further limited proactive maintenance and dynamic environmental optimization, leaving building operations mostly reactive and inefficient.

Key Challenges

- 1. Fragmented IoT Ecosystem:** The coexistence of diverse and non-interoperable IoT systems created silos that restricted seamless data sharing and intelligent decision-making.
- 2. Energy Inefficiency:** Outdated sensors and legacy systems could not automatically adapt to real-time occupancy or environmental shifts, causing significant energy losses.
- 3. Health and Safety Concerns:** Traditional office environments did not adequately support post-pandemic health standards, such as proper ventilation, air quality monitoring, and safe spacing of occupants.
- 4. Integration Complexity:** Combining multiple IoT vendors and systems into a unified, functional framework demanded considerable technical effort and investment, slowing down scalability.

Identified Limitations

- Real-time data analytics for predictive maintenance and environmental regulation were scarcely implemented.

- Existing IoT infrastructures were isolated and rigid, limiting scalability and adaptability across larger deployments.
- Artificial intelligence tools for occupant comfort, seat allocation, and spatial optimization were underdeveloped.

Technology Readiness Level (TRL)

- **Current TRL:** 4 — Technologies successfully validated under laboratory conditions.
- **Description:** Early-stage production systems demonstrated functionality but lacked operational maturity for full-scale deployment.
- **Core Challenges:** Managing, updating, and ensuring continuous 24/7 operation across diverse, large-scale IoT ecosystems remained technically demanding and inefficient.

After aerOS Implementation

After the rollout of aerOS, enterprise building management changed from a collection of disconnected systems into one coordinated platform. The solution brought together IoT devices under a single framework, allowing them to share data instantly and work together without conflict. This shift turned isolated operations into a continuous flow of information that supports smarter decisions and real-time optimization.

Main Changes

1. **Connected IoT Environment:** aerOS links different types of IoT devices so they communicate easily and exchange live data, creating a single, consistent system.
2. **Lower Energy Use:** Smart controls powered by AI adjust devices such as Smart Plugs, Air Purifiers, and Dehumidifiers automatically. This reduces power consumption while keeping rooms comfortable.
3. **Healthier Workplaces:** Using a web-based tool, the system suggests where people should sit based on safety, air quality, and comfort. This helps maintain a healthy and efficient work environment.
4. **Scalable Design:** The aerOS edge–cloud structure allows quick expansion from a single room to an entire building, making it flexible for future needs.

Benefits After Implementation

- **Energy Savings:** Up to 20% lower energy costs thanks to automated, AI-driven control.
- **Health and Safety:** Real-time air quality monitoring and adaptive seating keep workplaces safe and compliant.
- **Ease of Use:** Simple apps and dashboards give users clear insights and easy system control.
- **Operational Stability:** Predictive maintenance keeps systems running longer and with fewer interruptions.
- **Workplace Safety:** Automation cuts down manual tasks in risky areas, reducing human error.
- **Employee Satisfaction:** Smarter seat recommendations make workspaces more comfortable.
- **Sustainability:** Better resource use and reduced waste support long-term environmental goals.

Technology Readiness Level (TRL)

- **Status:** TRL 7 — Systems tested and proven in real environments.
- **Benefits:** Lower costs, improved comfort, and full compliance with sustainability standards.

Infrastructure and Technology

Pilot 5 uses a mix of advanced hardware and software to get the most out of aerOS.

- **IoT Sensors:** Devices track energy use, light, CO₂ levels, temperature, humidity, motion, and desk occupancy. Gateways collect and share this information in real time.

- **Back-End Tools:** Software such as **InfluxDB, MQTT, Grafana, Prometheus,** and **HomeAssistant** handle data processing and visualization.
- **AI Systems:** The **Health and Energy Optimization AI** automatically adjusts HVAC, lighting, and ventilation systems to balance comfort and efficiency.
- **Seat Recommendation Engine:** Built on the **aerOS Data Fabric**, it suggests seating plans that improve air quality and save energy.
- **User Interface:** A simple app gives users direct control and insights, keeping them engaged and informed.
- **FIWARE Context Broker:** Maintains data consistency and ensures all components communicate effectively.

Objectives and Benefits

Pilot 5 shows how aerOS can improve the way buildings operate by combining smart automation with efficient design.

1. **Demonstrate aerOS in Action:** Show how aerOS enhances safety, comfort, and efficiency through intelligent automation and IoT management.
2. **Reduce Energy Waste:** Use **Frugal AI** to cut energy use without affecting comfort or performance.

Stakeholder Benefits

- **Predictive Maintenance:** Issues are detected early, reducing downtime.
- **Comfort and Safety:** Smart systems make workplaces more pleasant and secure.
- **Cost Savings:** Open-source tools and shared standards lower setup and maintenance costs.
- **Scalability:** The modular system fits small offices and large buildings alike.
- **Employee Focus:** Personalized seating and comfort features raise satisfaction and productivity

Post-Project Vision for Pilot 5

The long-term goal of **Pilot 5** is to redefine smart-building management with scalable, efficient, and health-focused technologies. Building on the pilot's success, the project's next phase emphasizes broader product offerings, continued research, new market development, and strong collaborative partnerships. Together, these efforts aim to make **aerOS** a core enabler of intelligent and sustainable building ecosystems.

Product Development : The IoT framework established during the pilot provides a base for future upgrades and new capabilities tailored to enterprise users.

- **Predictive Maintenance and AI Energy Control** The next stage will enhance predictive algorithms to identify faults early and automate energy optimization, lowering both operational costs and environmental impact.
- **Integrated Scalable Platforms** A full smart-building suite will be developed for large organizations and property developers, covering automation, tenant comfort, and resource efficiency.
- **Ongoing R&D** Continuous research will keep **Pilot 5** at the forefront of IoT and AI innovation, refining existing functions and exploring new use cases.
- **Advanced Facility-Management Tools** Future development will include occupancy forecasting, smart allocation of resources, and adaptive configuration features to improve flexibility and efficiency.

Market Expansion

The success of **Pilot 5** creates a path to position **aerOS** as a leading smart-building solution across multiple regions and industries.

- **Target Sectors:** Large corporate campuses, property developers, and urban planners are the main focus areas. These groups value sustainability, operational reliability, and user comfort—all core strengths of aerOS.
- **Geographic Reach:** Expansion will first focus on Europe and North America, where sustainable-infrastructure initiatives and ESG requirements are growing quickly.

Collaborative Networks

Partnerships will play a central role in scaling and improving the technology.

- **IoT and HVAC Partners:** Working with hardware manufacturers and technology suppliers will ensure smooth integration and support a wide range of devices.
- **Enterprise Clients:** Close cooperation with client organizations will provide real-world feedback, helping refine features and maintain relevance.
- **Academic Collaboration:** Continued partnerships with universities and research centers will strengthen development in AI, edge-cloud computing, and IoT systems, while also offering access to emerging talent and innovation.

7.5.2. Lean Canvas

Pilot 5 illustrates the effectiveness of aerOS in addressing key issues in enterprise building management. The combination of IoT integration, Frugal AI, and modular edge–cloud architecture demonstrates a path toward sustainable, adaptable, and health-focused workplace environments. This lean canvas (Table 54) outlines the strategic approach to maximizing the pilot's commercial and operational potential.

Energy-Efficient, Health-Safe, and Sustainable Smart Buildings				
Problem	Solution	Value Proposition	Unfair Advantage	Customer Segments
• Fragmented IoT Infrastructure: Lack of interoperability among diverse IoT devices and systems. • Energy Inefficiency: Inability of legacy HVAC and smart-plug systems to dynamically optimize energy consumption. • Post-Pandemic Health Risks: Inadequate air quality monitoring and insufficient social distancing measures in traditional office layouts. • Complex Integration: High resource requirements for incorporating multiple IoT vendors into a cohesive system.	• Integrated IoT Ecosystem • Energy Optimization with Frugal AI • Health-Safe Workspaces • Scalable and Modular Design	A comprehensive, vendor-agnostic smart building solution that combines: • Energy Savings of up to 20% • Enhanced Health Safety Compliance by 80% with real-time monitoring and adjustments • Modular and Future-Proof Systems tailored to diverse enterprise needs • Open-Source Adaptability ensuring long-term relevance and easy customization • 99.99 system availability building upon the edge-cloud continuum	• Vendor-Agnostic Design: Ensures compatibility with a wide range of IoT devices and systems. • Modular Components: Facilitates scaling for diverse building infrastructures. • Expert Partner Network: Collaborations with OTE, NCSRD, FOGUS, and INF collectively drive innovation and reliability.	• Primary Customers: ◦ Large enterprises ◦ Real estate developers ◦ Corporate campuses. • Secondary Customers: ◦ SMEs seeking scalable, cost-effective building solutions. • Niche Markets: ◦ Urban planners ◦ Agencies focused on sustainable infrastructure.
		Key Metrics	Channels	
		• 20% Reduction in Energy Consumption • 80% Improvement in Health Safety Compliance • 99.99% Service Availability	• Direct Engagement through partner networks like OTE and NCSRD. • Corporate SaaS Licensing via end-user applications. • Participation in Trade Shows, Digital Innovation Hubs, and IoT Conferences. • Promotions through pilot partners' existing customer bases.	
Cost Structure		Revenue Streams		
• Development Costs: AI model creation, IoT device integration, system architecture. • Operational Costs: Maintenance of IoT infrastructure and edge-cloud systems. • Marketing Costs: Campaigns for awareness and trade show participation.		• SaaS Subscriptions for smart building applications. • Licensing Fees for proprietary web-based tools like seating recommendations. • Custom Installations and Consulting for tailored enterprise deployments. • Potential Government Funding for sustainable infrastructure initiatives.		

Figure 61 Pilot 5's Business Model Canvas

Table 54 Pilot 5 Lean Canvas

Category	Details
Problem	Fragmented IoT Infrastructure: Lack of interoperability among diverse IoT devices and systems. Energy Inefficiency: Inability of legacy HVAC and smart-plug systems to dynamically optimize energy consumption. Post-Pandemic Health Risks: Inadequate air quality monitoring and insufficient social distancing measures in traditional office layouts. Complex Integration: High resource requirements for incorporating multiple IoT vendors into a cohesive system.
Solution	Integrated IoT Ecosystem: Interoperability through aerOS enables seamless device communication and data utilization. Energy Optimization with Frugal AI: AI-driven HVAC, smart-plugs, and lighting systems minimize energy use while ensuring occupant comfort. Health-Safe Workspaces: AI-powered seating recommendations optimize layouts to enhance safety and productivity. Scalable and Modular Design: Dynamic scaling supports enterprise growth, adapting across rooms, floors, and buildings.
Unique Value Proposition	A comprehensive, vendor-agnostic smart building solution that combines: Energy Savings of up to 20% Enhanced Health Safety Compliance by 80% with real-time monitoring and adjustments Modular and Future-Proof Systems tailored to diverse enterprise needs Open-Source Adaptability ensuring long-term relevance and easy customization 99.99% system availability building upon the edge-cloud continuum.
Customer Segments	Primary Customers: Large enterprises, real estate developers, and corporate campuses. Secondary Customers: SMEs seeking scalable, cost-effective building solutions. Niche Markets: Urban planners and agencies focused on sustainable infrastructure.
Channels	Direct Engagement: Through partner networks like OTE and NCSRD. Corporate SaaS Licensing: Via end-user applications. Industry Events: Participation in trade shows, digital innovation hubs, and IoT conferences. Promotional Campaigns: Leveraging pilot partners' existing customer bases.
Revenue Streams	SaaS Subscriptions: For smart building applications. Licensing Fees: For proprietary web-based tools such as seating recommendations. Custom Installations and Consulting: Tailored enterprise deployments. Government Funding: Potential support for sustainable infrastructure initiatives.
Cost Structure	Development Costs: AI model creation, IoT device integration, and system architecture design. Operational Costs: Maintenance of IoT infrastructure and edge-cloud systems. Marketing Costs: Awareness campaigns and participation in trade shows.
Key Metrics	Energy Reduction: 20% decrease in energy consumption.

	Health Safety Improvement: 80% improvement in compliance levels. Service Availability: 99.99% uptime for mission-critical building management.
Unfair Advantage	Vendor-Agnostic Design: Ensures compatibility with a wide range of IoT devices and systems. Modular Components: Facilitate scaling across diverse building infrastructures. Expert Partner Network: Collaborations with OTE, NCSRD, FOGUS, and INF collectively drive innovation and reliability.

7.5.3. SWOT Analysis

The following SWOT analysis provides an overview of Pilot 5 – Smart Buildings, outlining the main factors that shape its progress and adoption. It highlights the pilot’s strengths in AI-driven energy management, health-focused workspace design, and seamless IoT integration, while also recognizing challenges such as integration complexity and upfront investment requirements. The analysis also looks at the growing opportunities created by the global move toward sustainable, intelligent infrastructure, as well as the potential risks linked to competition and changing regulations in the smart-building market.

Pilot 5 SWOT Analysis Diagram

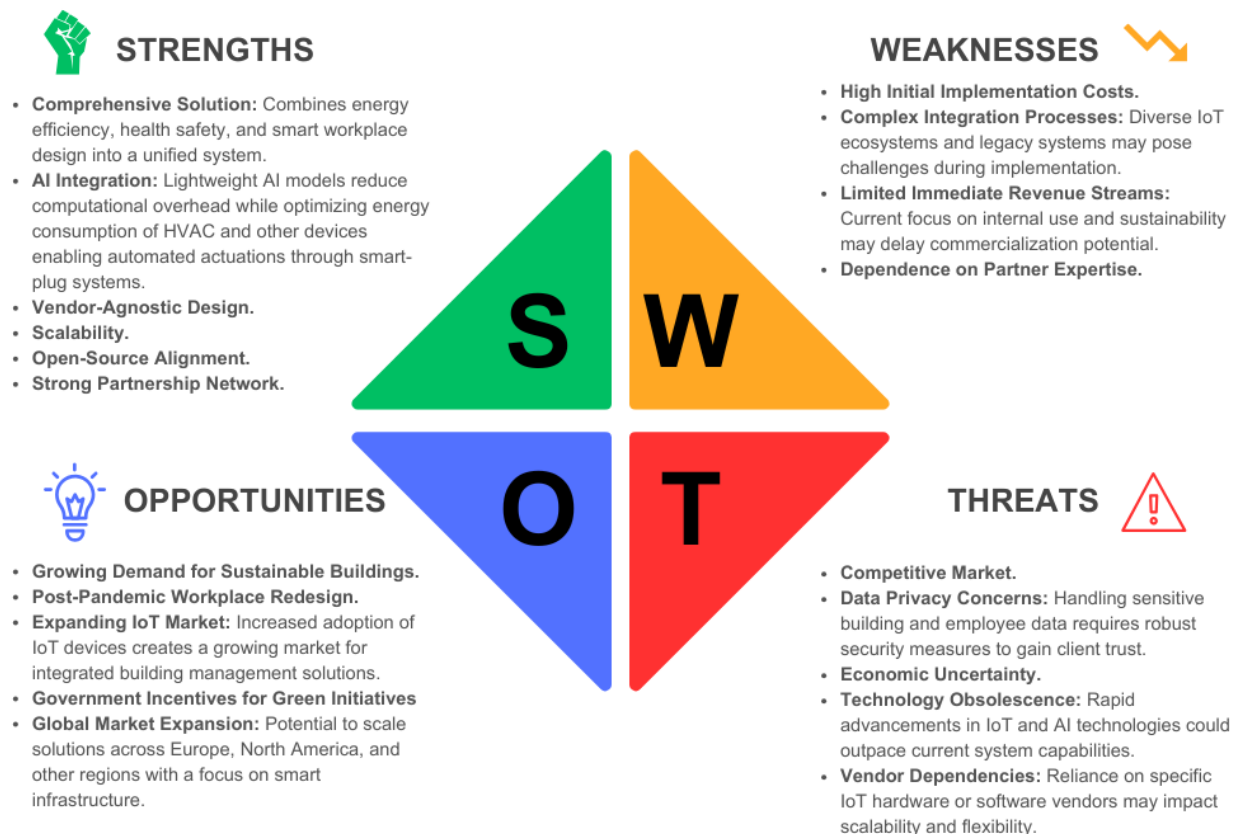


Figure 62 Pilot 5’s SWOT Analysis

Table 55 Pilot 5 SWOT Analysis

Category	Details
Strengths	Comprehensive Solution: Combines energy efficiency, health safety, and smart workplace design into a unified system. AI Integration: Lightweight AI models reduce computational overhead while optimizing energy consumption of HVAC and other devices enabling automated actuations through smart-plug systems. Vendor-Agnostic Design: Ensures seamless integration of diverse IoT devices, providing flexibility and future-proofing the system. Scalability: Modular architecture supports dynamic scaling across rooms, floors, and entire campuses. Open-Source Alignment: Incorporates community best practices, ensuring cost-effectiveness and adaptability. Strong Partnership Network: Collaborations with OTE, NCSRD, FOGUS, and INF drive innovation and implementation efficiency.
Weaknesses	High Initial Implementation Costs: IoT device integration and infrastructure upgrades can require significant investment. Complex Integration Processes: Diverse IoT ecosystems and legacy systems may pose challenges during implementation. Limited Immediate Revenue Streams: Current focus on internal use and sustainability may delay commercialization potential. Dependence on Partner Expertise: Success relies heavily on the collaboration and technical expertise of project partners.
Opportunities	Growing Demand for Sustainable Buildings: Enterprises prioritize energy-efficient solutions aligned with ESG goals and regulatory requirements. Post-Pandemic Workplace Redesign: Hybrid work models drive the need for flexible, health-safe office environments. Expanding IoT Market: Increased adoption of IoT devices creates a growing market for integrated building management solutions. Government Incentives for Green Initiatives: Funding and support for sustainable infrastructure projects can accelerate adoption. Global Market Expansion: Potential to scale solutions across Europe, North America, and other regions with a focus on smart infrastructure.
Threats	Competitive Market: Saturation of proprietary IoT solutions poses challenges for adoption. Data Privacy Concerns: Handling sensitive building and employee data requires robust security measures to gain client trust. Economic Uncertainty: Budget constraints in organizations may delay investment in smart building solutions. Technology Obsolescence: Rapid advancements in IoT and AI technologies could outpace current system capabilities. Vendor Dependencies: Reliance on specific IoT hardware or software vendors may impact scalability and flexibility.

7.5.4. Llava Matrix

The LLAVA Matrix (Table 56) for Pilot 5 highlights the collaborative synergies between project partners OTE, NCSR, FOGUS, and INF. This framework emphasizes user needs, business models, and iterative innovation, ensuring that aerOS-enabled solutions are not only technically feasible but also economically sustainable and user-centric. Below is the LLAVA Matrix, detailing the alignment of the partners' roles and contributions within the joint exploitation plan.

Table 56 Pilot5 Llava Matrix

Dimension	Description	Outcome
Customer Segment	- Enterprises and real estate developers seeking energy-efficient, health-safe workplace solutions.	- Enhanced market outreach to large enterprises, real estate companies, and urban planners prioritizing sustainable infrastructure.
Common Need	- Reduce energy consumption and improve workplace safety while maintaining flexibility and scalability in building management.	- Comprehensive smart building system addressing modern enterprise requirements post-pandemic.
Value Proposition	- Vendor-agnostic, scalable, and cost-effective IoT solutions leveraging Frugal AI and edge-cloud continuum for seamless integration.	- Energy savings of up to 20%, improved air quality and safety, and enhanced user experience through automated systems and AI-driven recommendations.
Solution	- aerOS meta-operating system enabling interoperability, predictive maintenance, AI-driven optimization, and modular scaling across building infrastructures.	- Integrated smart building management system with actionable insights, real-time analytics, and intuitive user interfaces.
Value Network	- Key Partners: - OTE: System deployment and enterprise offerings leveraging 5G. - NCSR: AI tools for HVAC optimization and environmental monitoring. - FOGUS: Recommendation engine for user-centric building management. - INF: End-user applications for workspace optimization and employee well-being. - Collaborative Opportunities: Extend partnerships with terminal operators and equipment manufacturers for broader market reach.	- Unified Smart Building System combining energy efficiency, health safety, and workplace flexibility.
Competition	- Existing proprietary predictive maintenance and OCR-based CV tools tailored to specific equipment vendors.	- Differentiators: aerOS's vendor-agnostic architecture, Frugal AI models optimized for edge devices, and scalability across diverse operational contexts.
Willingness to Pay	- Enterprises willing to invest in sustainable and scalable solutions to meet ESG goals and improve operational efficiency. - Recurring costs through subscription models for software updates, CV functionalities, and predictive maintenance services. - High market potential for solutions addressing port digitization and compliance with sustainability regulations.	- Potential for tiered pricing models for SaaS offerings, enterprise licensing, or customized deployments, making the system appealing to both SMEs and large-scale enterprises.

7.5.5. Porter's Five Forces Analysis

The Porter's Five Forces Analysis (Table 58) explores the competitive landscape surrounding Pilot 5 – Smart Buildings, focusing on the external factors that influence its position in the IoT-based building management market. The analysis looks at key elements such as barriers to entry, supplier and buyer power, potential substitutes, and the overall level of industry competition. By understanding these forces, Pilot 5 can identify the best ways to strengthen its market position and develop strategies that support long-term growth and sustainability.

PILOT 5 PORTER'S FIVE FORCES ANALYSIS

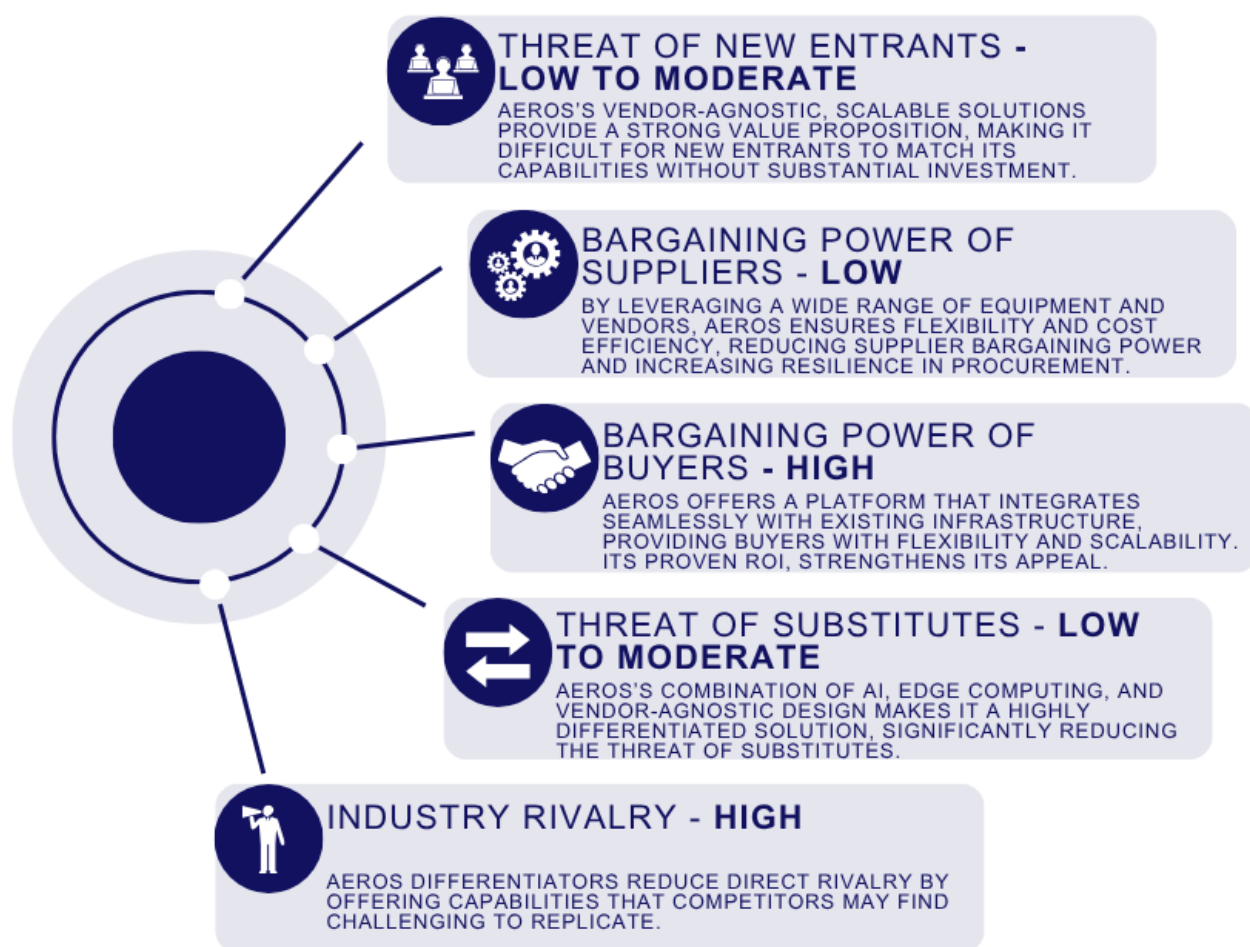


Figure 63 Pilot 5's Porter's Five Forces Analysis

Table 57 Pilot 5's Porter's Five Forces Analysis

c	Column 2
Threat of New Entrants (Low to Moderate)	Barriers to Entry: The smart building IoT market requires significant expertise, resources, and established networks to deliver IoT and AI-driven solutions. Trust and reputation are critical, as enterprises rely on proven, reliable systems. Pilot 5 Advantage: aerOS' vendor-agnostic, scalable solutions provide a strong value proposition, making it difficult for new entrants to match its technological capabilities without substantial investment.

Bargaining Power of Suppliers (Low)	Supplier Dependency: Reliance on multiple technology providers, such as IoT gateways, sensors, and AI tools, reduces dependency on any single supplier. Standardized protocols and interoperability further mitigate supplier power. Pilot 5 Strategy: By leveraging a wide range of equipment and vendors, aerOS ensures flexibility and cost efficiency, reducing supplier bargaining power and increasing resilience in procurement.
Bargaining Power of Buyers (High)	Buyer Dynamics: Real estate and large enterprises are the primary buyers and tend to seek customized, high-value solutions to address specific operational challenges. While demand for digitization is growing, buyers often negotiate extensively for tailored systems and long-term cost savings. Pilot 5 Advantage: aerOS offers a unique, vendor-agnostic platform that integrates seamlessly with existing infrastructure, providing buyers with flexibility and scalability. Its proven ROI, demonstrated by Pilot 5, strengthens its appeal and bargaining position.
Threat of Substitutes (Low to Moderate)	Existing Alternatives: Some proprietary predictive maintenance systems exist, but they are often tied to specific vendors and lack the flexibility and scalability of aerOS. There are no known real-time recommendation systems with actuator capabilities balancing energy-efficiency and health-safety. Pilot 5 Edge: aerOS's combination of AI, edge computing, and vendor-agnostic design makes it a highly differentiated solution, significantly reducing the threat of substitutes.
Industry Rivalry (High)	Competitive Landscape: The IoT-enabled smart building sector is saturated with competitors, including major players offering proprietary solutions. The growing emphasis on digitization has increased competition. Pilot 5 Positioning: aerOS stands out due to its scalable, interoperable architecture and innovative features like predictive maintenance and advanced CV models. These differentiators reduce direct rivalry by offering capabilities that competitors may find challenging to replicate.

7.5.6. Conclusion

Pilot 5 uses the advanced features of aerOS to solve many of the challenges modern workplaces face. It delivers a smart, energy-efficient, and health-focused building solution that helps organizations improve both comfort and performance. With its scalable design and seamless IoT connectivity, the pilot sets the groundwork for future-ready infrastructure built on sustainability and reliability. By continuing to refine its AI features, expanding into new markets, and working closely with partners such as COSM, NCSR, FOGUS, INF, and UPV, Pilot 5 is extending its value far beyond the OTE office building in Athens. Its outcomes are shaping how buildings operate around the world and helping position aerOS as a leader in smart, sustainable building management.

7.6. Summary

The combined results of the five aerOS pilots highlight the platform's ability to bring together different industrial sectors under one intelligent, digital, and sustainable framework. Each pilot contributes unique expertise and technological progress, yet together they create a shared exploitation strategy that strengthens individual outcomes and drives faster cross-sector innovation. This collaborative model confirms aerOS as a cornerstone for Europe's move toward Industry 5.0, where technology, sustainability, and human-centered design work in balance.

From Pilot 1's focus on sustainable manufacturing and zero-defect production to Pilot 5's advancements in smart building management and energy efficiency, the aerOS ecosystem proves that innovation can be both scalable and adaptable. Pilot 2 advances renewable-powered edge-cloud computing for data-intensive operations, Pilot 3 introduces precision agriculture through frugal AI and cooperative machinery, and Pilot 4 enhances port logistics with predictive maintenance and computer vision. Together, these pilots validate the

flexibility of aerOS, showing that one interoperable platform can improve efficiency, safety, and environmental performance across many industries.

The joint exploitation approach builds on shared technology, business models, and knowledge exchange to maximize results. Core technological elements, such as the Frugal AI framework, vendor-neutral architecture, and edge-cloud orchestration, make it easier to reuse solutions across pilots and support interoperability. This approach strengthens scalability and helps create commercially viable products. It also promotes an open, ecosystem-based business model where research organizations, SMEs, and industrial partners collaborate continuously, creating a self-sustaining cycle of innovation and market adaptation.

From an economic perspective, the pilots give aerOS strong potential for market growth. Its modular, open-source, and energy-efficient design lowers entry barriers for SMEs, enabling broader participation in digital transformation. Flexible models such as SaaS and licensing options allow adoption across multiple sectors—from factory automation and logistics to sustainable urban and building management. In parallel, aerOS supports key EU priorities including the Green Deal, the Digital Europe Programme, and the Sustainable Development Goals (SDGs), aligning digital innovation with environmental responsibility.

On the technological side, aerOS sets a foundation for standardization and regulatory consistency across Europe. Its open, vendor-agnostic interfaces help reduce market fragmentation and invite collaboration from external developers who can create new services and extensions. This openness supports long-term ecosystem growth, safeguards Europe's technological independence, and enhances its competitiveness in the global digital economy.

At the societal level, the pilots demonstrate the tangible benefits of sustainable digital transformation—lower energy use, safer working conditions, and greener operations. The solutions developed within aerOS show how innovation can directly improve quality of life, strengthen the economy, and support environmental goals. The combined impact extends beyond the individual pilots, shaping a shared vision where intelligence, sustainability, and cooperation drive the digital future.

In conclusion, the joint exploitation of the five aerOS pilots provides a proven, cross-sector model for innovation and commercialization. By combining advanced technologies with practical business strategies, the aerOS ecosystem shows that it is ready for large-scale deployment and long-term sustainability. With its strong technical foundation, active collaboration among partners, and alignment with EU policy, aerOS stands out as a key enabler of Europe's smart, green, and resilient digital economy—supporting growth, competitiveness, and social benefit well beyond the project's duration.

8. Conclusion

Deliverable D6.3 marks the completion of aerOS's impact generation and monitoring activities, offering a clear overview of the results achieved across communication, dissemination, standardisation, and exploitation during the second reporting period (M19–M36). Building on the foundations set in D6.1 and the interim findings of D6.2, this final report shows how the project has met, and in many cases exceeded, its Key Performance Indicators (KPIs) and overall objectives for impact creation.

Throughout its duration, aerOS has maintained strong visibility and engagement through a well-coordinated communication strategy, combining its website, social media presence, newsletters, and media outreach. These efforts have significantly increased awareness of the project among European research, industrial, and policy-making communities.

The project's dissemination activities have also strengthened its scientific and industrial presence. With numerous peer-reviewed papers, conference contributions, and live demonstrations, aerOS has successfully showcased the real-world value of its technologies across the edge–cloud continuum. Partner participation in key European and international events has further expanded its reach and fostered collaboration between sectors.

In the area of standardisation, aerOS has made active contributions to major Standard Development Organisations (SDOs) and pre-standardisation efforts, including ETSI, 5G-ACIA, and AIOTI. These efforts support Europe's leadership in developing open and interoperable frameworks for the Cloud–Edge–IoT continuum.

From an exploitation standpoint, the project has defined and refined a solid set of Key Exploitable Results (KERs), supported by detailed business models and sustainability plans for each pilot. The joint exploitation strategy under WP6 outlines how aerOS outcomes can continue generating value well beyond the project's lifetime, not only commercially, but also in shaping future innovation, policy, and standardisation efforts.

Ultimately, aerOS has achieved its main goal: creating a sustainable, open, and reliable meta operating system that connects cloud and edge computing. Its influence extends beyond technology, contributing to Europe's digital sovereignty and laying the groundwork for future cooperation, open-source growth, and industrial adoption.

As the project concludes, the consortium remains committed to maintaining the aerOS ecosystem, ensuring that its technologies, standardisation contributions, and business outcomes continue to drive innovation, competitiveness, and long-term impact across Europe's digital landscape

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A. Annexes including IPR background and foreground

Table 58 Background IP registry

#	Relevant Background	Contributing Partner	Background Number (First number refers to WP relevance, second number refers to assets order)	Short Description of BG	Type of Protection (patent, copyright, TM, Utility model , Open source...)
1	Network Data Fabric	TID	BG 3.1	Data fabric platform for the integration of data collected from the network. The implementation of the data fabric will be based on knowledge graphs technologies and standards such as W3C RDF and ETSI NGSI-LD. This work is the evolution of the former Semantic Data Aggregator (SDA) component that was developed in previous European projects.	open-source
2	End-to-end IoT	COSMOTE	BG5.5	End-to-end IoT solution of COSMOTE (incl. sensors, gateways, backend infrastructure for measurements' storage, processing and visualization).	Copywrite
3	ContinuumIOTAMessages	UPV	BG 4.1	A custom mechanism that takes place utilizing IOTA Tangle so that Infrastructure Elements of aerOS form a DAG (Directed Acyclic Graph) to exchange certain specific (critical) messages and the trust score of such IEs.	
4	Self-scalingASSIST-IoT	UPV	BG 3.2	A customized software based on Kubernetes' HPA (Horizontal Pod Autoscaler) that is able to improve the horizontal scalability (in replicas) whenever a computing element surpasses an overloading threshold.	Apache 2.0

5	SmartOrchestratorASSIST-IoT	UPV	BG 3.3	It is a custom software based on open source ETSI OSM for deploying virtualized workloads (Docker containers) over Kubernetes clusters (and multi-cluster scenarios) based on policies and tiny predictions. This was developed by UPV in the context of project ASSIST-IoT.	Apache 2.9
6	M3 Software	INNOVALIA	BG 5.1	M3 software and its point cloud analysis capability brings enough potential to analyse and extract geometric elements, as well as the ability to compare different point clouds and CAD objects. The tool provides the possibility to extract geometric shapes in both 2D and 3D and through its analysis obtain information relevant to decision making in the process of manufacturing parts.	Copyright
7	Trust Manager	IQB	BG 4.2	Trust Management for cloud native services, including static security assessment of containers and dynamic assessment based on real time data and behaviour analysis of containers and nodes and detection of anomaly patterns.	open-source
8	Recommendation System	FOGUS	BG 5.3	Recommendation System is a software component of pilot 5, that outputs a list of recommended workstations to an employee.	
9	IE self-healing capability	FOGUS	BG 3.4	IE self-healing capability is a software component of an IE that provides the capability to recover from abnormal states. It is part of a greater self-* capabilities suite, that allows an IE to be self-managed.	Apache License, Version 2.0

10	Web app virtual assistant	INFOLYSIS	BG 5.4	A web application that will act as virtual assistant/information portal for the users of a smart building and will also initiate an effective and easy-to-use automated chat-based interaction/communication between the end-user and the building's smart characteristics/features. This chat-based web app will be developed to support aerOS Pilot 5.	Proprietary License
11	Self-security	S21Sec	BG 3.5	Self-security module it enables malfunctions and vulnerabilities to be detected at the node level to ensure correct operation or secure incorporation into the computing continuum. It does this by monitoring the network traffic of the IE's network interfaces, checking against updated threat databases or applying rules to detect attacks. The attack information is sent to the self-diagnose component.	Other (internal usage for clients services in S21Sec)
12	Tillage AI Model	John Deere		AI model for optimizing cultivator working depth in secondary tillage.	Copywrite
13	Smart Networking	NCSRD	BG 3.6	Script-based programmability on exposed capabilities for optimised and intelligent service mesh networking	Open-source
14	DSTech-Management Portal	DST	BG 4.3	A Portal for the management of information extracted from every deployed domain in the edge-cloud continuum.	open-source

15	Semantic Translator	SPIRAS	BG 4.4	Semantic Translator offers a service, that transforms RDF data according to rules provided by the user. The translation can be performed either in batch or utilizing (reactive) streaming interface. Both Apache Kafka and MQTT brokers can be used as input/output.	open-source
16	Semantic Annotator	SPIRAS	BG4.5	Semantic Annotator offers a syntactic transformation service, that annotates data in JSON, XML or CSV formats and lifts it into RDF. The annotation is done through persistent configurable streams on Apache Kafka and/or MQTT brokers. Transformations are defined with CARML, which is a dialect of RML - RDF Mapping Language	open-source
17	Model Reduction Service	SPIRAS	BG4.6	Services exposing functions that can be used to reduce/compress ML model to address frugality requirements.	open-source
18	Decentralized AI	SPIRAS	BG4.7	Interacting components allowing to perform federated learning or deploy a model for inference.	open-source
19	Explainability Service	SPIRAS	BG4.8	Service wrapping popular methods to explain/interpret ML models.	open-source

20	aerOS Service Allocation with AI	SIEMENS	BG3.7	This IP asset includes the approaches, algorithms, and components needed to allocate services in a dynamic network to achieve the Quality-of-Service requirements of service users. We focus mainly on using AI, specifically Reinforcement Learning, to solve the optimization problem more efficiently than state-of-the-art methods like Mixed Integer Programming problems, as described in D3.1.	Proprietary License
21	Machine Learning Operations Pipeline	SIEMENS	BG3.8	This IP asset includes the concepts and components needed to provide a machine learning operation pipeline for AI services. This allows a user to train, track, deploy and monitor the machine learning approach in a scalable manner, as described in D3.1.	Proprietary License
22	aerOS Integration Service	SIEMENS	BG3.9	Integration services act as essential connectors, bridging diverse systems with different protocols to facilitate seamless communication and data exchange. These services play a crucial role in streamlining the connection of heterogeneous data from IoT devices, described in D3.1.	Proprietary License

23	aerOS TSN Integration	SIEMENS	BG3.10	This IP encompasses all software components and algorithms needed to achieve the integration of the aerOS Smart Networking functionalities with a TSN (Time Sensitive Networking) network. This means at least two basic components, an aerOS TSN Auxiliary Service and the template for a TSN-capable aerOS Service, both described in D3.1.	Proprietary License
24	Network Data Fabric	TID	BG 4.9	Data fabric platform for the integration of data collected from the network. The implementation of the data fabric will be based on knowledge graphs technologies and standards such as W3C RDF and ETSI NGSI-LD. This work is the evolution of the former Semantic Data Aggregator (SDA) component that was developed in previous European projects.	open-source

Table 59 Foreground IP registry

Work Package	PR number	Project Result (PR) /Achievement	Main Contributing Partner	Further Contributing Partner(s)	Related Background Number	Short Description of FG	Foreground Number
WP3	PR 3.1	Self toolsuite	UPV			A set of functionalities (in the form of inter-connected microservices) that complement each other and that enhance the capacity of self-managing (monitoring, orchestration, diagnose) of an Infrastructure Element in an aerOS continuum.	FG 3.1
	PR 3.2	Self-scalingASSIST-IoT	UPV		BG 3.2	A customized software based on Kubernetes' HPA (Horizontal Pod Autoscaler) that is able to improve the horizontal scalability (in replicas) whenever a computing element surpasses an overloading threshold.	FG 3.2
	PR 3.3	SmartOrchestratorASSIST-IoT	UPV		BG 3.3	It is a custom software based on open source ETSI OSM for deploying virtualized workloads (Docker containers) over Kubernetes clusters (and multi-cluster scenarios) based on policies and tiny predictions. This was developed by UPV in the context of project ASSIST-IoT.	FG 3.3
	PR 3.4	IE self-healing capability	FOGUS	UPV, All T3.5 partners	BG 3.4	IE self-healing capability is a software component of an IE that provides the capability to recover from abnormal states. It is part of a greater self-* capabilities suite, that allows an IE to be self-managed.	FG 3.4
	PR 3.5	Smart Networking	NCSR		BG 3.6	Script-based programmability on exposed capabilities for optimised and intelligent service mesh networking	FG 3.5

	PR 3.6	Self-security	S21Sec		BG 3.5	Self-security module it enables malfunctions and vulnerabilities to be detected at the node level to ensure correct operation or secure incorporation into the computing continuum. It does this by monitoring the network traffic of the IE's network interfaces, checking against updated threat databases or applying rules to detect attacks. The attack information is sent to the self-diagnose component.	FG 3.6
	PR 3.7	aerOS Service Allocation with AI	SIEMENS		BG3.7	This IP asset includes the approaches, algorithms, and components needed to allocate services in a dynamic network to achieve the Quality-of-Service requirements of service users. We focus mainly on using AI, specifically Reinforcement Learning, to solve the optimization problem more efficiently than state-of-the-art methods like Mixed Integer Programming problems, as described in D3.1.	FG3.7
	PR 3.8	Machine Learning Operations Pipeline	SIEMENS		BG3.8	This IP asset includes the concepts and components needed to provide a machine learning operation pipeline for AI services. This allows a user to train, track, deploy and monitor the machine learning approach in a scalable manner, as described in D3.1.	FG3.8

	PR 3.9	aerOS Low Code Tools	SIEMENS		-	Low-code tools, emphasizing behavior trees, streamline application development by minimizing manual coding. Behavior trees offer a visual, node-based approach for defining application logic, simplifying the creation and modification of behaviors. This low-code paradigm facilitates rapid prototyping, accelerates development cycles, and promotes collaboration between technical and non-technical team members.	FG3.9
	PR 3.10	aerOS OpenAPI	SIEMENS		-	OpenAPI, or the OpenAPI Specification (OAS), is a standard for documenting RESTful APIs. It uses JSON or YAML to describe API structure, endpoints, parameters, and authentication. This standardized documentation streamlines API development, making it easier for developers to understand, collaborate, and integrate applications across different platforms.	FG3.10
	PR 3.11	aerOS Integration Service	SIEMENS		BG3.9	Integration services act as essential connectors, bridging diverse systems with different protocols to facilitate seamless communication and data exchange. These services play a crucial role in streamlining the connection of heterogeneous data from IoT devices, described in D3.1.	FG3.11

	PR 3.12	aerOS TSN Integration	SIEMENS		BG3.10	This IP encompasses all software components and algorithms needed to achieve the integration of the aerOS Smart Networking functionalities with a TSN (Time Sensitive Networking) network. This means at least two basic components, an aerOS TSN Auxiliary Service and the template for a TSN-capable aerOS Service, both described in D3.1.	FG3.12
	PR 3.13	Self-realtimeness prototype implementation for time-aware orchestration in the cloud-to-edge continuum	TTC	TCAG	-	This software will enable application developers to specify soft real-time requirements for their application(s) in form of an expected time-utility that should be guaranteed during runtime. On a self-realtimeness enabled infrastructure element an operating system extension monitors the time-utility of deployed applications. If the time-utility of an application drops below the user-specified requirement, the infrastructure element will trigger a reorchestration request. Additionally, the infrastructure element frequently reports applications' and the total time-utility to the orchestrator so that time-utility is taken into account during orchestration decisions.	FG 3.13
WP4	PR 4.1	ContinuumIOTAMessages	UPV	IQB	BG 4.1	A custom mechanism that takes place utilizing IOTA Tangle so that Infrastructure Elements of aerOS form a DAG (Dyrected Acyclic Graph) to exchange certain specific (critical) messages and the trust score of such IEs.	FG 4.1

	PR 4.2	aerOS Federator	UPV	FIWARE		This will be a custom software that will be in charge of creating, updating and maintaining the cross-registrations, publications/subscriptions and the proper configurations upon the distributed state repository and Data Fabric Context Brokers (ORIONs). It will be the heart that will allow the abstraction (federation) of domains and IEs across the continuum in aerOS.	FG 4.2
	PR 4.3	Trust Manager	IQB		BG 4.2	Trust Management for cloud native services, including static security assessment of containers and dynamic assessment based on real time data and behaviour analysis of containers and nodes and detection of anomaly patterns.	FG 4.3
	PR 4.4	DSTech-Management Portal	TDST	UPV, INF, NCRSD	BG 4.3	A Portal for the management of information extracted from every deployed domain in the edge-cloud continuum.	FG 4.4
	PR4.5	Semantic Translator	SPIRAS		BG 4.4	Semantic Translator offers a service, that transforms RDF data according to rules provided by the user. The translation can be performed either in batch or utilizing (reactive) streaming interface. Both Apache Kafka and MQTT brokers can be used as input/output.	FG4.5

	PR4.6	Semantic Annotator	SPIRAS		BG4.5	Semantic Annotator offers a syntactic transformation service, that annotates data in JSON, XML or CSV formats and lifts it into RDF. The annotation is done through persistent configurable streams on Apache Kafka and/or MQTT brokers. Transformations are defined with CARML, which is a dialect of RML - RDF Mapping Language	FG4.6
	PR4.7	Model Reduction Service	SPIRAS		BG4.6	Services exposing functions that can be used to reduce/compress ML model to address frugality requirements.	FG4.7
	PR4.8	Decentralized AI	SPIRAS		BG4.7	Interacting components allowing to perform federated learning or deploy a model for inference.	FG4.8
	PR4.9	Explainability Service	SPIRAS		BG4.8	Service wrapping popular methods to explain/interpret ML models.	FG4.9

	PR 4.10	Network Data Fabric	TID		BG 4.9	Data fabric platform for the integration of data collected from the network. The implementation of the data fabric will be based on knowledge graphs technologies and standards such as W3C RDF and ETSI NGSI-LD. This work is the evolution of the former Semantic Data Aggregator (SDA) component that was developed in previous European projects.	FG 4.10
WP5	PR 5.1	M3 Software	INNOVALIA		BG 5.1	M3 software and its point cloud analysis capability brings enough potential to analyse and extract geometric elements, as well as the ability to compare different point clouds and CAD objects. The tool provides the possibility to extract geometric shapes in both 2D and 3D and through its analysis obtain information relevant to decision making in the process of manufacturing parts.	FG 5.1
	PR 5.2	HPCP Prototype extended with the NVIDIA-based support packages	TTC		BG 5.2	A suite of software libraries to support the Pliot 3 integration and to allow to follow best coding practices, like writing the code that works consistently across different versions and devices so that the partner working with the TTC's HPCP prototype can focus on their code they care about, like e.g. AI-supported models, etc.	FG 5.2

	PR 5.3	Recommendation System	FOGUS	All pilot 5 partners	BG 5.3	Recommendation System is a software component of pilot 5, that outputs a list of recommended workstations to an employee.	FG 5.3
	PR 5.4	Web app virtual assistant	INFOLYSIS		BG 5.4	A web application that will act as virtual assistant/information portal for the users of a smart building and will also initiate an effective and easy-to-use automated chat-based interaction/communication between the end-user and the building's smart characteristics/features. This chat-based web app will be developed to support aerOS Pilot 5.	FG 5.4

Table 60 Exploitable Results

ER number	Exploitable Result (ER)	Short Description	Main Partner(s)	Contributing Partners
ER1	aerOS	Operating system as a whole. This KER entails the essential, bare minimum software modules that any aerOS compliant deployment must have.	Consortium	
ER5	DevPrivSec	Process and data flow, including techniques and open source technologies that, combined, improve current DevSecOps de-facto standards.	Consortium	
ER6	ContinuumIOTAMessages	A custom mechanism that takes place utilizing IOTA Tangle so that Infrastructure Elements of aerOS form a DAG (Directed Acyclic Graph) to exchange certain specific (critical) messages and the trust score of such IEs.	UPV	IQB
ER7	Self-scalingASSIST-IoT	A customized software based on Kubernetes' HPA (Horizontal Pod Autoscaler) that is able to improve the horizontal scalability (in replicas) whenever a computing element surpasses an overloading threshold.	UPV	

ER8	SmartOrchestratorASSIST-IoT	A customized software based on Kubernetes' HPA (Horizontal Pod Autoscaler) that is able to improve the horizontal scalability (in replicas) whenever a computing element surpasses an overloading threshold.	UPV	
ER9	Self toolsuite	A set of functionalities (in the form of inter-connected microservices) that complement each other and that enhance the capacity of self-managing (monitoring, orchestration, diagnose) of an Infrastructure Element in an aerOS continuum.	UPV	
ER10	aerOS Federator	This will be a custom software that will be in charge of creating, updating and maintaining the cross-registrations, publications/subscriptions and the proper configurations upon the distributed state repository and Data Fabric Context Brokers (ORIONs). It will be the heart that will allow the abstraction (federation) of domains and IEs across the continuum in aerOS.	UPV	FIWARE
ER11	M3 Software	M3 software and its point cloud analysis capability brings enough potential to analyse and extract geometric elements, as well as the ability to compare different point clouds and CAD objects. The tool provides the possibility to extract geometric shapes in both 2D and 3D and through its analysis obtain information relevant to decision making in the process of manufacturing parts.	INNOVALIA	
ER12	HPCP Prototype extended with the NVIDIA-based support packages (software)	A suite of software libraries to support the Pliot 3 integration and to allow to follow best coding practices, like writing the code that works consistently across different versions and devices so that the partner working with the TTC's HPCP prototype can focus on their code they care about, like e.g. AI-supported models, etc.	TTC	

ER13	Trust Manager	Trust Management for cloud native services, including static security assessment of containers and dynamic assessment based on real time data and behaviour analysis of containers and nodes and detection of anomaly patterns.	IQB	
ER14	Recommendation System	Recommendation System is a software component of pilot 5, that outputs a list of recommended workstations to an employee.	FOGUS	All pilot 5 partners
ER15	IE self-healing capability	IE self-healing capability is a software component of an IE that provides the capability to recover from abnormal states. It is part of a greater self-* capabilities suite, that allows an IE to be self-managed.	FOGUS	UPV, All T3.5 partners
ER16	Web app virtual assistant	A web application that will act as virtual assistant/information portal for the users of a smart building and will also initiate an effective and easy-to-use automated chat-based interaction/communication between the end-user and the building's smart characteristics/features. This chat-based web app will be developed to support aerOS Pilot 5.	INFOLYSIS	INFOLYSIS
ER17	Self-security	Self-security module it enables malfunctions and vulnerabilities to be detected at the node level to ensure correct operation or secure incorporation into the computing continuum. It does this by monitoring the network traffic of the IE's network interfaces, checking against updated threat databases or applying rules to detect attacks. The attack information is sent to the self-diagnose component.	S21Sec	
ER18	Smart Networking	Script-based programmability on exposed capabilities for optimised and intelligent service mesh networking	NCSR	
ER19	Management Portal	A Portal for the management of information extracted from every deployed domain in the edge-cloud continuum.	DST	UPV, INF, NCSR

ER20	Semantic Translator	Semantic Translator offers a service, that transforms RDF data according to rules provided by the user. The translation can be performed either in batch or utilizing (reactive) streaming interface. Both Apache Kafka and MQTT brokers can be used as input/output.	SPIRAS	
ER21	Semantic Annotator	Semantic Annotator offers a syntactic transformation service, that annotates data in JSON, XML or CSV formats and lifts it into RDF. The annotation is done through persistent configurable streams on Apache Kafka and/or MQTT brokers. Transformations are defined with CARML, which is a dialect of RML - RDF Mapping Language	SPIRAS	
ER22	Model Reduction Service	Services exposing functions that can be used to reduce/compress ML model to address frugality requirements.	SPIRAS	
ER23	Decentralized AI	Interacting components allowing to perform federated learning or deploy a model for inference.	SPIRAS	
ER24	Explainability Service	Service wrapping popular methods to explain/interpret ML models.	SPIRAS	
ER25	aerOS Service Allocation with AI	This IP asset includes the approaches, algorithms, and components needed to allocate services in a dynamic network to achieve the Quality-of-Service requirements of service users. We focus mainly on using AI, specifically Reinforcement Learning, to solve the optimization problem more efficiently than state-of-the-art methods like Mixed Integer Programming problems, as described in D3.1.	SIEMENS	

ER26	Machine Learning Operations Pipeline	This IP asset includes the concepts and components needed to provide a machine learning operation pipeline for AI services. This allows a user to train, track, deploy and monitor the machine learning approach in a scalable manner, as described in D3.1.	SIEMENS	
ER27	aerOS Low Code Tools	Low-code tools, emphasizing behavior trees, streamline application development by minimizing manual coding. Behavior trees offer a visual, node-based approach for defining application logic, simplifying the creation and modification of behaviors. This low-code paradigm facilitates rapid prototyping, accelerates development cycles, and promotes collaboration between technical and non-technical team members.	SIEMENS	
ER28	aerOS OpenAPI	OpenAPI, or the OpenAPI Specification (OAS), is a standard for documenting RESTful APIs. It uses JSON or YAML to describe API structure, endpoints, parameters, and authentication. This standardized documentation streamlines API development, making it easier for developers to understand, collaborate, and integrate applications across different platforms.	SIEMENS	
ER29	aerOS Integration Service	Integration services act as essential connectors, bridging diverse systems with different protocols to facilitate seamless communication and data exchange. These services play a crucial role in streamlining the connection of heterogeneous data from IoT devices, described in D3.1.	SIEMENS	