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Deliverable 11.4 "Final dissemination and standardisation report"

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Abstract

This document constitutes deliverable D11.4 "Final dissemination and standardisation report" of the Arrowhead fPVN project.

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Executive Summary

This deliverable (D11.4) presents the final report on dissemination and communication activities carried out throughout the Arrowhead fPVN project, within the framework of Work Package 11 (WP11). Led by UNSTPB as WP11 leader, and implemented in close collaboration with all project partners, these activities were designed to ensure strong visibility, effective stakeholder engagement, and sustained awareness of the project's objectives, technological developments, and impact across Europe.

The dissemination and communication strategy was guided by the Dissemination and Communication Plan (D11.2), which established a structured approach to audience targeting, channel selection, content creation, and brand consistency. The strategy focused on addressing key stakeholder groups—including industrial actors, research and academic communities, policymakers, and standardization bodies—while fostering synergies with related European initiatives, particularly in the domains of interoperability, digital engineering, and secure industrial data ecosystems.

Throughout the project lifecycle (M1–M36), Arrowhead fPVN maintained a consistent and dynamic presence across both digital and physical channels. Core dissemination tools included the project website, active social media engagement (notably LinkedIn and Twitter/X), newsletters, videos, and dedicated factsheets for use cases and technical results. These were complemented by active participation in major industrial and scientific events, as well as the organization of workshops and webinars aimed at promoting stakeholder interaction and knowledge exchange.

Scientific dissemination played a key role in ensuring the visibility and credibility of project outcomes, with results published in peer-reviewed journals, conferences, and contributions to standardization and clustering activities. In parallel, the project leveraged its strong technical foundation in service-oriented architectures, semantic interoperability, and digital engineering to position itself within the broader European innovation landscape.

The Arrowhead fPVN visual identity and communication framework, as defined in D11.1, ensured a coherent and professional image across all dissemination materials and platforms. This unified branding reinforced project recognition and supported effective communication of complex technical concepts to diverse audiences.

A KPI-driven monitoring approach enabled continuous assessment of dissemination performance, allowing the consortium to refine and optimize communication efforts over time. As a result, the project achieved significant outreach, strong engagement within the industrial IoT and digital engineering communities, and meaningful contributions to European collaboration and standardization efforts.

The successful execution of Task 11.1 has ensured wide dissemination of project results and established a solid foundation for post-project visibility, exploitation, and sustainability. This deliverable consolidates all dissemination and communication activities undertaken throughout the project and serves as the final comprehensive record of outreach efforts within Arrowhead fPVN.

1. Introduction

1.1 Project Introduction

The Arrowhead fPVN project aims to enable secure, interoperable, and scalable Production Value Networks (PVNs), supporting Europe's industrial digitalisation through advanced service-oriented architectures and data-driven solutions. This deliverable presents the dissemination, communication, and standardisation activities of the project, outlining the strategy, tools, and results achieved in engaging stakeholders and promoting project outcomes. It reflects the project's commitment to ensuring high visibility, effective knowledge transfer, and long-term impact, while supporting the uptake and sustainability of its innovations.

1.2 Deliverable purpose

The document includes all the activities on dissemination, communication, standardisation and exploitation that have been undertaken by the consortium partners during the third and last year of the project (M24-M36).

1.3 Intended readership

This deliverable is public and therefore is mainly addressed to the Arrowhead fPVN Consortium partners, the European Commission (funding authority), as well as other audiences who are interested in learning more about the project. The deliverable will be made available on the Arrowhead fPVN website once approved by the European Commission.

1.4 Relationship with other deliverables and tasks

- D11.1 – Deliverable D11.1 defines the overall dissemination, communication, and standardisation strategy for the Arrowhead fPVN project during its first two years. It outlines the project identity, target audiences, communication channels, and dissemination activities, including publications, events, and networking.
The document also establishes KPIs, monitoring processes, and a phased communication plan, ensuring structured outreach and impact over the project lifecycle. In addition, it presents the standardisation approach, identifying relevant standards, organisations, and potential contributions, as well as introducing the Innovation Catalogue concept to showcase project results. Overall, D11.1 serves as the strategic framework guiding all communication, dissemination, and standardisation efforts in the project.
- D11.2 – Deliverable D11.2 reports on the dissemination, communication, and standardisation activities carried out during the first year (Y1) of the Arrowhead fPVN project. It outlines how the project established its communication channels (website, social

media, newsletters), organised and participated in events and workshops, and initiated scientific publications and collaborations.

The report also presents the project's approach to standardisation, early contributions to relevant bodies, and the creation of key assets such as the innovation catalogue and dissemination toolkit. It includes KPIs and monitoring mechanisms to track impact and defines a forward-looking plan for Year 2, aiming to expand visibility, engagement, and industrial uptake.

Overall, D11.2 demonstrates a strong foundation for project visibility and impact, with structured activities and clear plans for future dissemination and standardisation efforts.

- D11.3 - Deliverable D11.3 presents a comprehensive overview of dissemination, communication, and standardisation activities carried out during Year 2 of the Arrowhead fPVN project, along with the planned actions for Year 3 and beyond. It highlights the project's strong progress in promoting its results through events, scientific publications, digital channels, and collaborations with other initiatives, while also reinforcing its contribution to industrial standardisation efforts.

The report emphasises continuous monitoring through KPIs, active partner involvement, and the use of diverse communication tools (website, social media, newsletters, and workshops) to maximise impact. It also outlines future plans focused on increasing engagement, expanding dissemination outputs, strengthening collaborations, and supporting exploitation and standardisation activities.

Overall, D11.3 demonstrates that dissemination and communication efforts have been highly effective, contributing significantly to the project's visibility, stakeholder engagement, and alignment with industrial needs, while setting a clear direction for the final project phase.

2. Dissemination and communications activities

2.1. Online Tools

2.1.1 Website

The Arrowhead fPVN website <https://fpvn.arrowhead.eu/fpvn-arrowhead/> The project website has been operational since June 2023 and is jointly managed by LTU, UPB, and BEIA, serving as a central digital entry point for the Arrowhead fPVN initiative. It provides a structured and comprehensive overview of the project, including detailed descriptions of all work packages and associated activities. A core component of the website is the Dissemination section, which systematically organises project outputs and partner contributions. This section ensures streamlined access to publications, results, and reference materials, thereby supporting citation and reinforcing the project's commitment to transparency and open access. In line with open science principles, dissemination materials generated by project partners are made publicly available to the greatest extent possible.

2.1.2 Social Media

The project's presence on social media was established ahead of its official launch, with accounts on X (formerly Twitter) and LinkedIn created to build early awareness and visibility. At a later stage, a dedicated YouTube channel was introduced to host promotional and informational video content related to the project.

In the final year, a targeted video campaign was launched to present the project's innovations in an accessible manner for non-technical audiences. This campaign showcased the Arrowhead fPVN tools through engaging multimedia content distributed across the project's social media channels. Overall, the project's social media activity has remained consistently high throughout its duration, significantly surpassing the communication and engagement targets initially set for the third year.

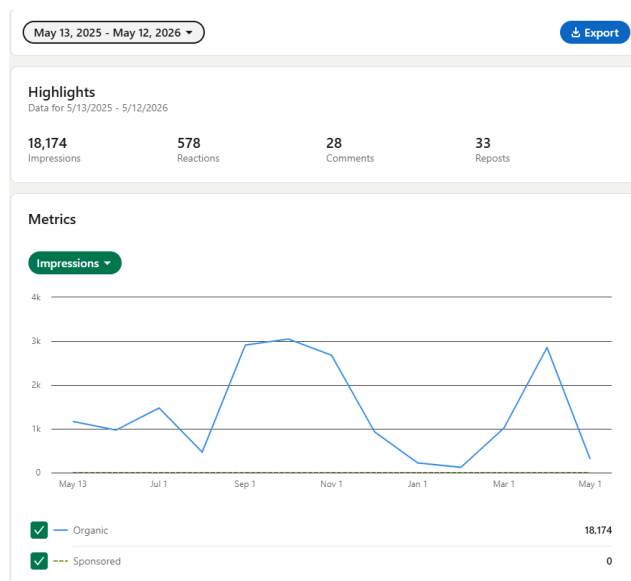


Figure 1: Arrowhead fPVN LinkedIn Analytics – Content

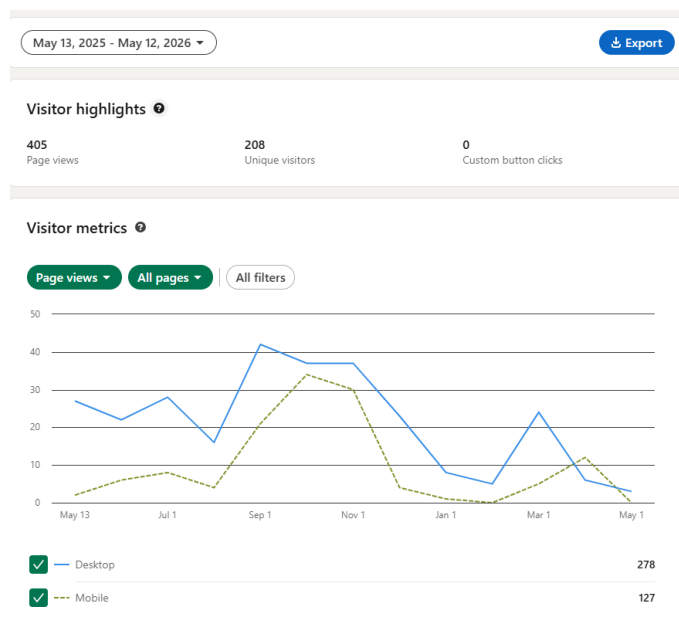


Figure 2: Arrowhead fPVN LinkedIn Analytics – Visitors

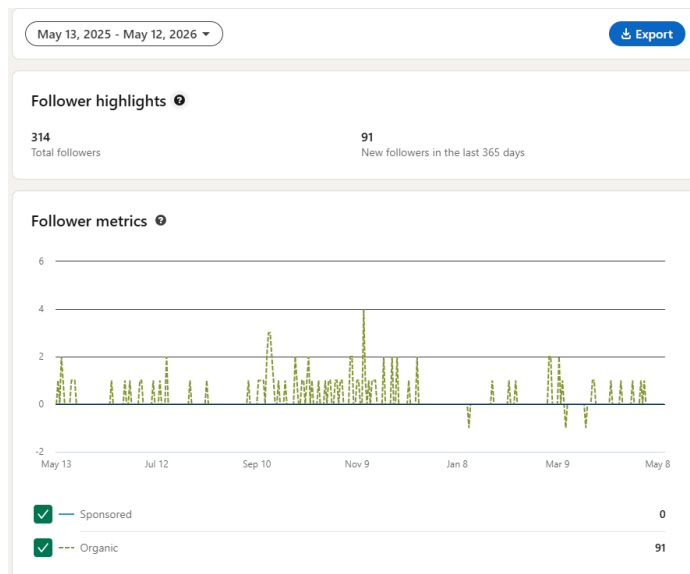


Figure 3: Arrowhead fPVN LinkedIn Analytics – Followers

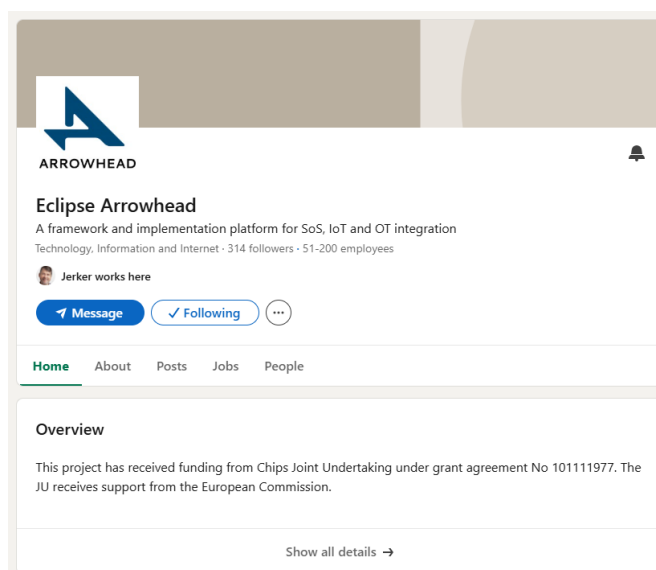


Figure 4: Arrowhead fPVN LinkedIn Page

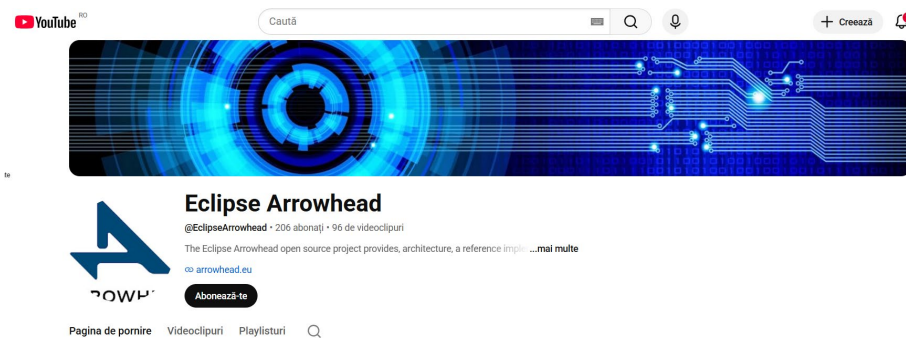


Figure 5: Arrowhead fPVN Youtube

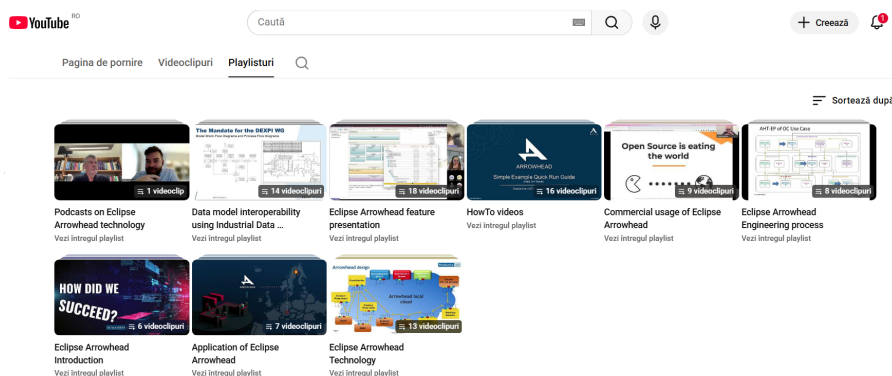


Figure 6: Arrowhead fPVN Youtube - Playlists

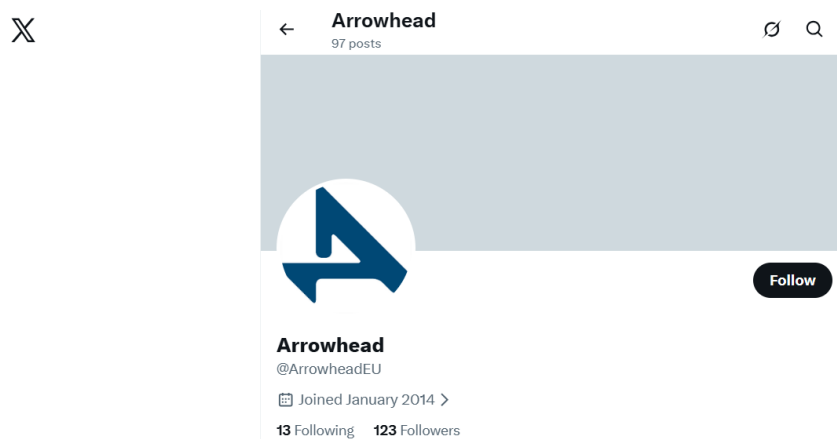


Figure 7: Arrowhead fPVN X Account

2.1.3 Zenodo Community

The Arrowhead fPVN Zenodo Community includes all the public information regarding the project such as the dissemination material (brochure, poster, banner, brand book, colour palette, logo), the e- newsletters, all the public deliverables approved by the EC along with the scientific papers that were submitted by the consortium partners in different conferences and workshops. The community is constantly updated.

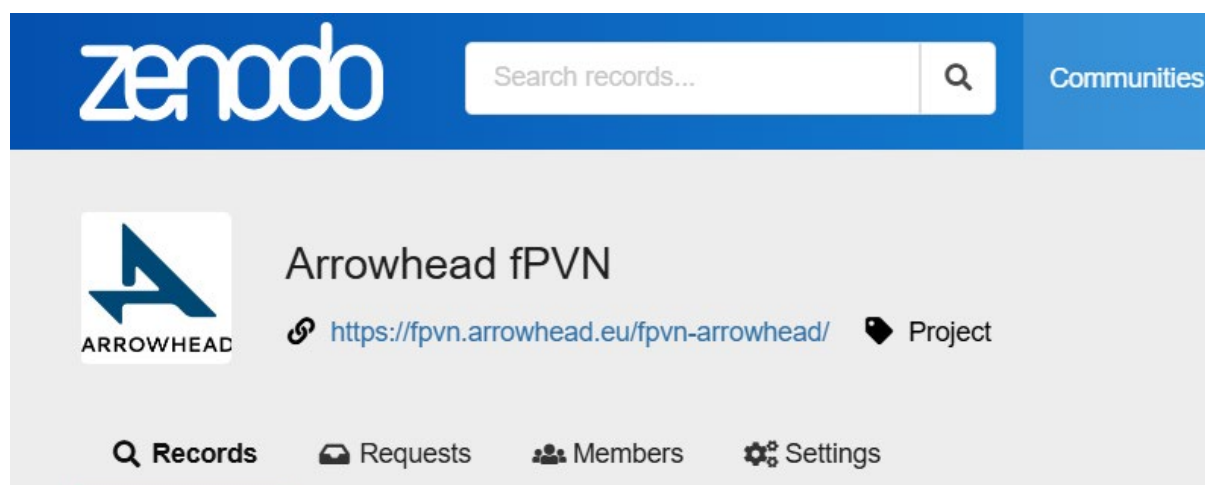


Figure 8: Arrowhead fPVN Zenodo Community

2.2. Dissemination Material

The following section presents the dissemination materials, both printed and published online, developed to support the communication of the Arrowhead fPVN project. Initially, it was planned to produce selected materials, such as posters and infographics in printed format to be used during face-to-face meetings, workshops, and conferences, where they could effectively support direct interaction and engagement with stakeholders.

At the same time, these materials were also designed in digital formats to ensure their usability in online events and broader dissemination channels. This approach enabled easy sharing through the project website and social media platforms, thereby extending their reach and ensuring continuous visibility of the project's objectives, activities, and results. The project's promotional material is available on the project's website and the Zenodo

community in downloadable format.



Figure 9: Arrowhead fPVN Technical Factsheet

Within the third year of the project (M24-M36), another three issues of the Arrowhead fPVN newsletter have been published (newsletter #2, newsletter #3 and newsletter #4) reaching the four (4) issues in total. The newsletters are sent to the people that have registered through the website, they are circulated through the social media and they are available both on the website and the Zenodo community.



Arrowhead fPVN Newsletter #1

 Eclipse Arrowhead
221 followers



January 30, 2025

Hello & Welcome

Welcome to the first edition of the Arrowhead fPVN LinkedIn Newsletter series. Arrowhead fPVN is an EU-funded project with the ambition to double European industrial productivity by enabling transformative, autonomous, and evolvable information interoperability within production value networks (PVNs). The project focuses on creating true value from interoperability by providing stakeholders with machine-interpretable content that enhances resilience and adaptability in manufacturing. The goal is to achieve seamless interoperability across a spectrum, from individual IoT devices to complex cyber-physical systems, fostering productivity and flexibility throughout the entire value network lifecycle.

Figure 10: Arrowhead fPVN Newsletter #1

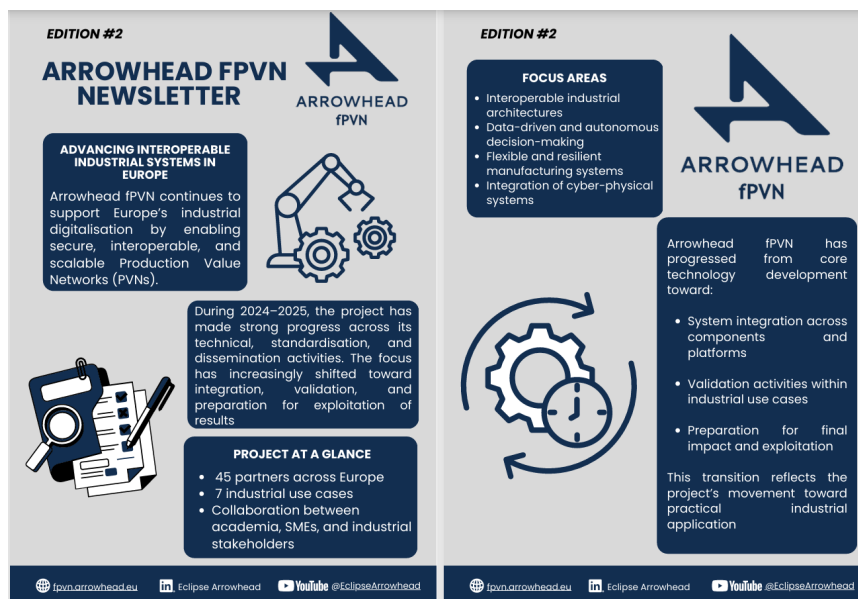


Figure 11: Arrowhead fPVN Newsletter #2

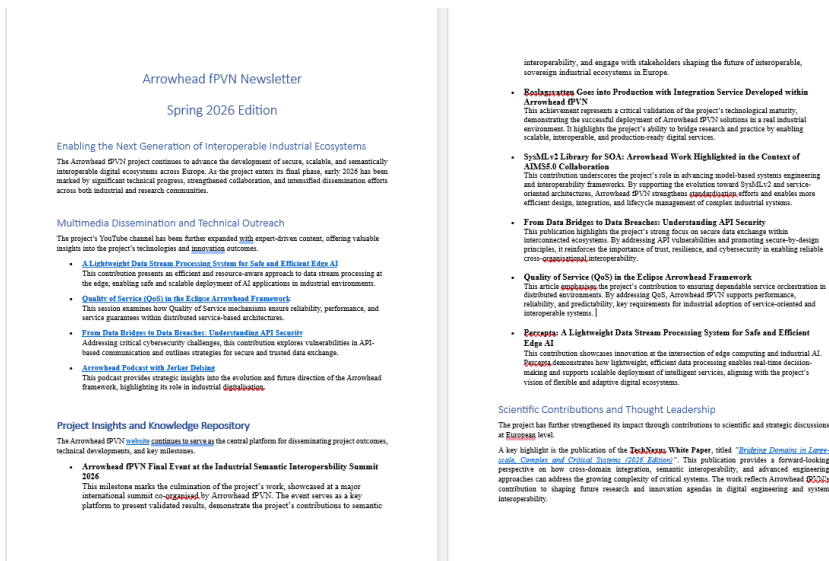


Figure 12: Arrowhead fPVN Newsletter #3

2.3. Videos

A general Arrowhead fPVN video depicting the project's aim and the solutions in a simple yet informative way was created to promote the project. The project is available on the project's YouTube channel and website and was communicated through the project's and partners' social media and websites.

The technical clips featured on the Arrowhead Project YouTube channel go beyond general presentations and focus on hands-on, implementation-oriented content that is especially valuable for engineers, developers, and system architects. These videos often break down how core components of the Eclipse Arrowhead Framework are configured and used in practice, including service registration, orchestration, authorization, and data exchange between systems. Viewers can follow step-by-step demonstrations, deployment examples, and architectural walkthroughs that illustrate how to build interoperable industrial applications using service-oriented principles.

In addition, many technical clips highlight integration scenarios within real use cases, showing how heterogeneous systems, such as IoT devices, legacy equipment, and cloud services, can be connected through standardized interfaces. The content frequently addresses practical challenges like scalability, security, and system resilience, offering insights into how these aspects are managed within distributed environments. Some videos also explore advanced topics such as semantic interoperability, model-based engineering approaches, and the evolution of supporting tools and libraries.

Overall, these technical clips function as applied learning resources, bridging the gap between conceptual architecture and real-world deployment. They enable viewers not only to understand the Arrowhead approach, but to replicate and adapt it within their own

industrial contexts.

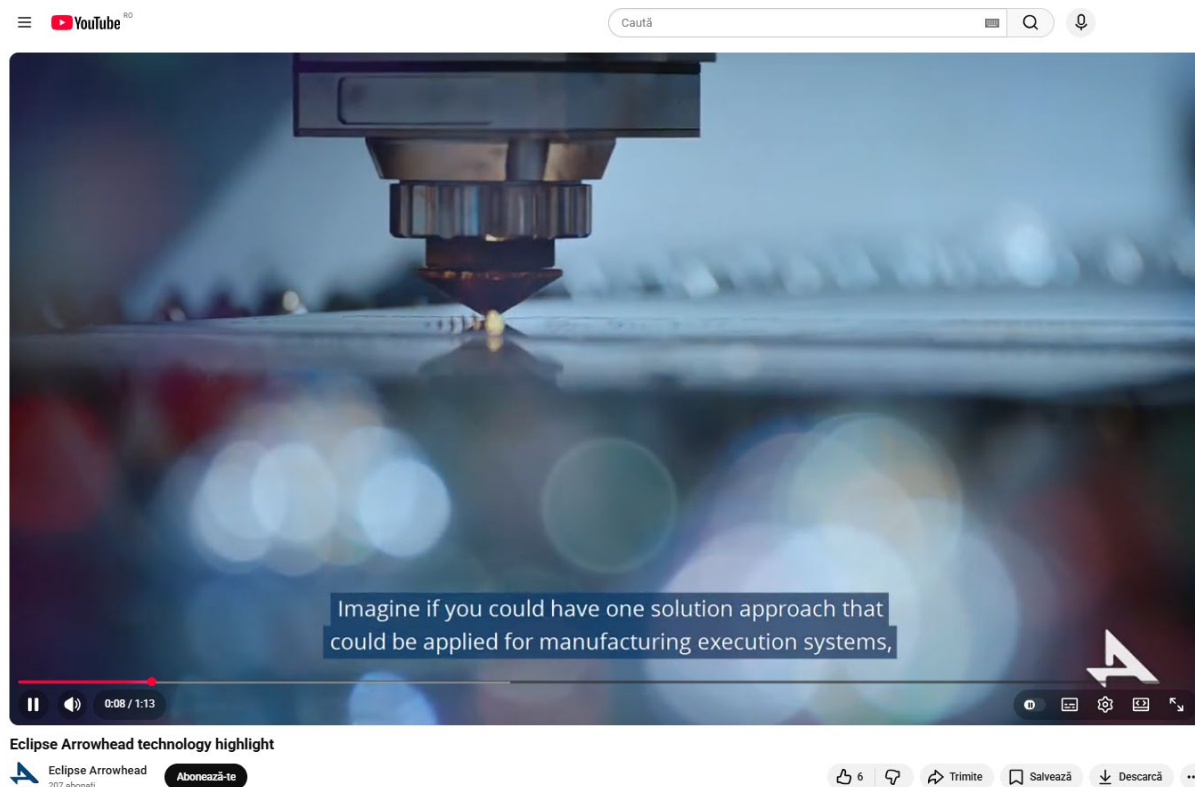


Figure 13: Screenshot from the Arrowhead fPVN videos

2.4. Events

Arrowhead fPVN participated in several events and conferences in the 3rd year of the project lifespan. Consortium representatives have networked and engaged with relevant stakeholders, as well as presented some of the core objectives of the project. The events concerning the 1st year of the project are available in the deliverable D11.1 Initial report on dissemination, communication, standardisation and exploitation, those of the 2nd year are presented in the deliverable D11.2 Interim report on dissemination, communication, standardisation and exploitation. The table below presents in short, a list with the events of the 3rd project's year. All the events are also available on the Arrowhead fPVN website in detail:

Event Name	Date	Location	Type
THTH Webinar	29 May 2024	Online	Webinar
Review Meeting	Jun 2024	Brussels	Project review
PIDMIC 3.0 @ ACHEMA	Jun 2024	Frankfurt	Industrial event
DISC Show & Tell	Sep 2024	Stavanger	Industry event
PLM Road Map & PDT Europe	Oct 2024	Gothenburg	Conference
ROBOFEST 2024	Nov 2024	Bucharest	Dissemination / outreach event
EFECS 2024	Nov 2024	Ghent	European forum
DEXPI General Meeting Q4	Nov 2024	Frankfurt	Standardisation
SCIC 2024	Dec 2024	Bucharest	Conference
HiPEAC 2025	Jan 2025	Barcelona	Conference
MedFest	Feb 2025	Bucharest	Expo

ETTI Day	Mar 2025	Bucharest	Academic/industry event
POLI International Fest	Mar 2025	Bucharest	Exhibition/fair
ICIN 2024	Mar 2025	Paris	Conference
Bitcoin Conference	Mar 2025	Bucharest	Conference
DEXPI General Meeting Q1	Mar 2025	—	Standardisation
General Assembly	May 2025	Emden	Consortium meeting
ICPS 2025	May 2025	Emden	Conference
Industry Forum @ ICPS	May 2025	Emden	Organized session
General Assembly	May 2025	Emden	Consortium meeting
ICPS 2025	May 2025	Emden	Conference
Industry Forum @ ICPS	May 2025	Emden	Organized session
IEEE BlackSeaCom	June 2025	Chisinau, Moldova	Presentation on AI,

2025 – Special Session			Blockchain, IoT integration
DevTalks Romania 2025	June 2025	Bucharest, Romania	Major tech conference participation
TRUST 2025 – Smart Cities Conference	June 2025	Bucharest, Romania	Smart city & industrial services session
SCSS – Student Scientific Communication Session	June 12, 2025	Bucharest, Romania	Honorable mention for research work
PLM Road Map & PDT Europe 2025	Oct 2025	(not specified)	Industry conference
Accelerating the Future of PLM & ALM – Workshop in Paris	4 November 2025	Paris, France	Expert workshop gathering professionals to discuss the future of PLM & ALM, focusing on AI, data-driven approaches, and interoperability.
HiPEAC 2026	Jan 2026	Krakow, Poland	Computing systems conference
ROHEALTH 2026	Jan 2026	Bucharest	Dissemination / outreach event
SysMLv2 Library for SOA – Arrowhead & AIMS5.0 Collaboration Presentation	March 2026		Presentation of a SysMLv2-based SOA library and Arrowhead DSL, highlighting AI integration and collaboration with AIMS5.0

Romtherm Construct Ambient 2026	March 2026	Bucharest	Dissemination / outreach event
GREEN ENERGY 2026	March 2026	Bucharest	Dissemination / outreach event
SpaceFEST 2026	May 2026	Bucharest	Dissemination / outreach event
POLI International FEST 2026	May 2026	Bucharest	Dissemination / outreach event
POLI AutoFEST 2026	May 2026	Bucharest	Dissemination / outreach event
Arrowhead fPVN Final Event – Industrial Semantic Interoperability Summit 2026	9–11 June 2026	Høvik (Oslo), Norway	Final Arrowhead fPVN event held within an international summit, focusing on semantic interoperability, industrial data standards, and collaboration with industry and research stakeholders.
BEiNG WiSE 3rd Training School	Aug 27–29, 2025	Litochoro, Greece	Cybersecurity & human factors

2.5. Publications

Arrowhead fPVN consortium partners have published peer-reviewed scientific papers in high-impact factor peer-reviewed journals and conference proceedings. The table below presents a list of the scientific papers of the third project year. All the publications, once they get published, are available on the Arrowhead fPVN website and the Zenodo Community.

No.	Title	Authors	Type	DOI
1	Virtualizing Operational Technology by Distributed Digital Twins	Aziz Abdullah	PhD Thesis	https://www.diva-portal.org/smash/record.jsf?pid=diva2%3A1818261&dswid=2570
2	Data-Driven Optimizations in Production Value Networks	Javed Salman	PhD Thesis	https://www.diva-portal.org/smash/record.jsf?pid=diva2%3A1919523&dswid=7196
3	Optimizing Smart Industries: Strategies for Efficient System of Systems Development	Tripathy Aparajita	PhD Thesis	https://ltu.diva-portal.org/smash/record.jsf?dswid=-8832&pid=diva2%3A2065977&c=10&searchType=LIST_COMING&language=en&query=&af=%5B%5D&aq=%5B%5B%5D%5D&aq2=%5B%5B%5D%5D&aqe=%5B%5D&noOfRows=50&sortOrder=author_sort_asc&sortOrder2=title_sort_asc&onlyFullText=false&sf=all
4	Unveiling Synergies: Integrating IEEE 1451 and ISO 15926 for Advanced Interoperability in Smart Manufacturing and Transportation	V. Tavakkoli; K. Mohsenzadegan ; W. V. Kambale; K. Kyamakya	Conference Paper	10.1109/ICECS61496.2024.10848585
5	Co-pilots for Arrowhead-based Cyber-Physical System of Systems Engineering	Csaba Hegedűs; Pál Varga	Conference Paper	10.1109/NOMS59830.2024.10575845
6	Integrating IEEE 1451 and IEC 61499 Standards for Enhanced Interoperability in Smart Manufacturing and Transportation Systems	V. Tavakkoli; K. Mohsenzadegan ; W. V. Kambale; K. Kyamakya	Conference Paper	10.1109/SMAP63474.2024.00013
7	Adaptive Kalman Filtering in Offset Estimation for Precision Time Protocol	G. Hollósi; D. Ficzero	Conference Paper	10.1109/TII.2024.3452248

8	ML-Based Translation Methods for Protocols and Data Formats	T. Tóthfalusi; E. Varga; Z. Csizsár; P. Varga	Conference Paper	10.23919/CNSM59352.2023.10327850
9	A model based implementation of an IoT framework	Jan van Deventer	Conference Paper	10.1109/ISSE65546.2025.11370084
10	Models2Code: Autonomous model-based generation to expedite the engineering process	Cristina Paniagua; Fernando Labra Caso	Conference Paper	10.1002/sys.21789
11	An approach towards demand response optimization at the edge in smart energy systems using local clouds	Salman Javed et al.	Conference Paper	10.1016/j.segy.2023.100123
12	AIMS5.0 AI Toolbox: Enabling Efficient Knowledge Sharing for Industrial AI	G. Hollósi et al.	Conference Paper	10.1109/NOMS59830.2024.10575076
13	Confidentiality Preserving Data Sharing for Life Cycle Assessment in Process Industries	H. Perera; U. D. Atmojo; V. Vyatkin	Conference Paper	10.1109/ETFA61755.2024.10710738
14	Multiprotocol Middleware Translator for IoT	B. Cabral et al.	Conference Paper	10.1109/DSD64264.2024.00051
15	Interoperability for Cyber-Physical Systems: An overview of challenges and research gaps	Siyu Chen; Pál Varga	Conference Paper	10.3311/WINS2024-009
16	Run-Time Value Chain Analysis and Cost Accounting via Microservices in Agile Manufacturing	Salman Javed et al.	Conference Paper	10.1109/OJIES.2025.3532664
17	A Time-synchronized Framework for Bluetooth Low	A. Pignata; V. Fra; E. Macii; G. Urgese	Conference Paper	10.1109/AICT61888.2024.10740423

	Energy Wireless Sensor Networks			
18	Utilizing Generative AI for Test Data Generation – use-cases for IoT and 5G Core Signaling	T. Tóthfalusi; Z. Csiszár; P. Varga	Conference Paper	10.1109/NOMS59830.2024.10574974
19	A Hybrid AI Framework Integrating Ontology Learning, Knowledge Graphs, and Large Language Models for Improved Data Model Translation	K. Mohsenzadegan et al.	Conference Paper	10.1109/SDF63218.2024.10773919
20	Towards Seamless Data Translation Based on Data Models: A Hybrid AI Framework for Smart Transportation and Manufacturing	K. Mohsenzadegan et al.	Conference Paper	10.1109/SMAP63474.2024.00022
21	Distributed Digital Twins as Proxies – Unlocking Composability and Flexibility for Purpose-Oriented Digital Twins	Abdullah Aziz et al.	Conference Paper	10.1109/ACCESS.2023.3340132
22	Visualization Approach for RAMI 4.0 Value Chain Analysis	Salman Javed et al.	Conference Paper	10.1109/OJIES.2024.3520410
23	Dynamically Sharded Ledgers on a Distributed Hash Table	C. Fink; O. Schelén; U. Bodin	Conference Paper	10.1145/3787963
24	Confidentiality Preserving Data Sharing for Life Cycle Assessment in Process Industries (extended version)	H. W. A. Dona; U. D. Atmojo; V. Vyatkin	Conference Paper	10.1109/ETFA61755.2024.10710738
25	Bridging Domains in Large-scale Complex and	C. Robinson(editor) , S. Lalis; D. Le-	Whitepaper	10.5281/zenodo.14920027

	Critical Systems – 2025 Edition	Phuoc; A. Zoitl; O. Fratu		
26	Architecting Scalable ICPS for the Automotive Industry	E.-C. Popovici et al.	Conference/ Journal	10.1109/ICPS65515.2025.11087856
27	On the Use of Metadata Templates to Capture Knowledge	P. Pinheiro et al.	Conference/ Journal	10.1109/DCOSS-IoT65416.2025.00166
28	Towards the evaluation of the Arrowhead SoA	L. Ribeiro et al.	Conference/ Journal	10.64552/wipiec.v11i1.91
29	A Real-Time Sybil Attack Detection for Vehicular Networks	S. S. Sefati et al.	Conference/ Journal	10.1109/WPMC67460.2025.11351272
30	A Smart Manufacturing Ecosystem for Industry 5.0 using Cloud-based Collaborative Learning at the Edge	S. Javed et al.	Conference Paper	10.1109/NOMS56928.2023.10154323
31	Improving a SALBP-1 Solver by Tuning Flexible Termination Criteria with Simulated Solving	C. Fink; O. Schelén; U. Bodin	Conference Paper	10.1109/ICPS65515.2025.11087837
32	How Beyond-5G and 6G Makes IIoT and the Smart Grid Green—A Survey	P. Varga et al.	Journal Article	10.3390/s25134222
33	Merging green vehicles and crowdsourcing for optimal last-mile deliveries	G. Colajanni; P. Daniele; D. Sciacca	Journal Article	10.3934/jdg.2025027
34	Unlocking the Power of Digital Transformation: The Role of Ontologies	O. Wintercorn; J. van Deventer; C. Paniagua	Conference Paper	10.1109/SysCon64521.2025.11014791
35	Adaptive GNSS–UWB Sensor Fusion for Reliable	A. Osman et al.	Journal Article	10.1016/j.atech.2026.101846

	Localization in Precision Agriculture			
36	TACO - A Generative AI Copilot for Intent-Based Telecommunication Core Network Analysis	T. Tóthfalusi; Z. Csiszár; P. Varga	Conference Paper	10.1109/NOMS57970.2025.11073654
37	Production Value Networks Use Cases for NVIDIA AI Microservices Integration in the Eclipse Arrowhead Framework	E.-C. Popovici et al.	Conference Paper	10.1109/ICIN64016.2025.10942762
38	Hybrid Recurrent Neural Network and Decision Tree Scheduling for Energy-Efficient Resource Allocation in Cloud Computing	Seyed Salar Sefati, Alexandru Vulpe, Alexandru Vulpe, Eduard Popovici and Octavian Fratu	Conference Paper	10.1051/epjconf/202532605007
39	A Probabilistic Approach to Load Balancing in Multi-Cloud Environments via Machine Learning and Optimization Algorithms	Seyed Salar Sefati · Ahmed M. Nor · Bahman Arasteh · Razvan Craciunescu · Ciprian-Romeo Comsa	Journal Article	10.1007/s10723-025-09805-6
40	Adaptive Service Recommendation in Internet of Things Using a Reinforcement Learning and Optimization Algorithm	Seyed Salar Sefati; Bahman Arasteh; Simona Halunga; Octavian Fratu	Journal Article	10.1109/TNSM.2025.3585995
41	Adaptive Resource Scheduling in Multi-Cloud Computing Using Recurrent Neural Forecasting and Memory-Based Metaheuristic Optimization	Seyed Salar Sefati · Mobina Keymasi · Razvan Craciunescu · Sanda Maiduc · Mustafa Bayram · Bahman Arasteh	Journal Article	10.1007/s10723-025-09812-7

42	Optimizing energy-efficient routing in Mobile Internet of Things (MIoT) networks using Grey Wolf Optimization and Recurrent Neural Networks	Seyed Salar Sefati , Sanda Osiceanu Maiduc , Bahman Arasteh , Winfred Ofoe Larkotey , Asgarali Bouyer , Wali Ullah Khan	Journal Article	10.1016/j.adhoc.2025.104047
43	Adaptive QoS-Aware Service Composition in the Internet of Things Using a Hybrid Bayesian Network–Based Optimization Algorithm	Seyed Salar Sefati , Seyedeh Tina Sefati ,Alexandru Vulpe ,Octavian Fratu	Journal Article	10.1109/JIOT.2026.3678869
44	What is a Digital Tweak? Multi-Modal Multi-Models for Holistic Engineering Governance	Géza Kulcsár, Asma Smaoui-Charfi, Jerker Delsing	Conference Paper	The papers will appear in IEEE Xplore once processed by IEEE
45	Latent Geometric Backbones for Resilient Greedy Routing in Hyperbolic Networks	Daniel Ficzer, Andras Majdan, Gergely Hollosi, Pal Varga, Jozsef Biro	Conference Paper	The papers will appear in IEEE Xplore once processed by IEEE
46	Engineering efficiency of Industry 5.0 Cyber Physical Systems	Jerker Delsing, Pal Varga, Paolo Azzoni	Conference Paper	The papers will appear in IEEE Xplore once processed by IEEE
47	Enhancing Intent Understanding in Telecommunication-Specific Applications of LLMs	T. Tothfalusi (AITIA International Inc., Hungary), C. Torok, A. Kovari (Budapest University of Technology and Economics, Hungary), C. Hegedus, P. Varga	Conference Paper	The papers will appear in IEEE Xplore once processed by IEEE

2.6. Workshops

Workshop Name	Date	Location	Type/ Focus
Arrowhead fPVN Consortium Workshop	Nov 2024	Budapest	Internal coordination
Joint Finnish-Swedish Technical Meeting	Sep 2024	Stora Enso HQ	IT/OT integration, interoperability
AIMS5.0 & Arrowhead fPVN Deep Tech Workshop	Nov 2024	Budapest (BME)	AI, DSL, interoperability
Workshop 1 – Arrowhead fPVN & DISC	08 Jan 2025	Stockholm (Arlanda)	Collaboration kickoff
Workshop 2 – Arrowhead fPVN, DISC & CFIHOS	19–20 Mar 2025	Oslo (Aker Solutions)	Semantic alignment
Workshop 3 – Arrowhead fPVN, DISC & CFIHOS	06–07 May 2025	Oslo	Continuation of WG work
VeryDeepTech #1 Workshop	Feb 2025	Luleå	Cyber architectures
Semantic Alignment Workshop Series (DISC collaboration)	2024–2025	Stockholm / Oslo	Standardisation & ontology work
AIMS5.0 & Arrowhead fPVN Deep Tech Workshop	Oct 2025	Lisbon, Portugal	Deep tech / interoperability
Joint Deep Tech Workshop	Oct 2025	Lisbon, Portugal	Collaboration with other projects

2.7. Other Activities

2.7.1 Arrowhead fPVN Partners Campaign

During the third project year, Arrowhead fPVN launched a video campaign so that we could engage even more people and promote the work performed within the project. The Arrowhead fPVN Tools video campaign includes simple visuals presenting the project's partners. The videos are available on the project's YouTube channel and the website.

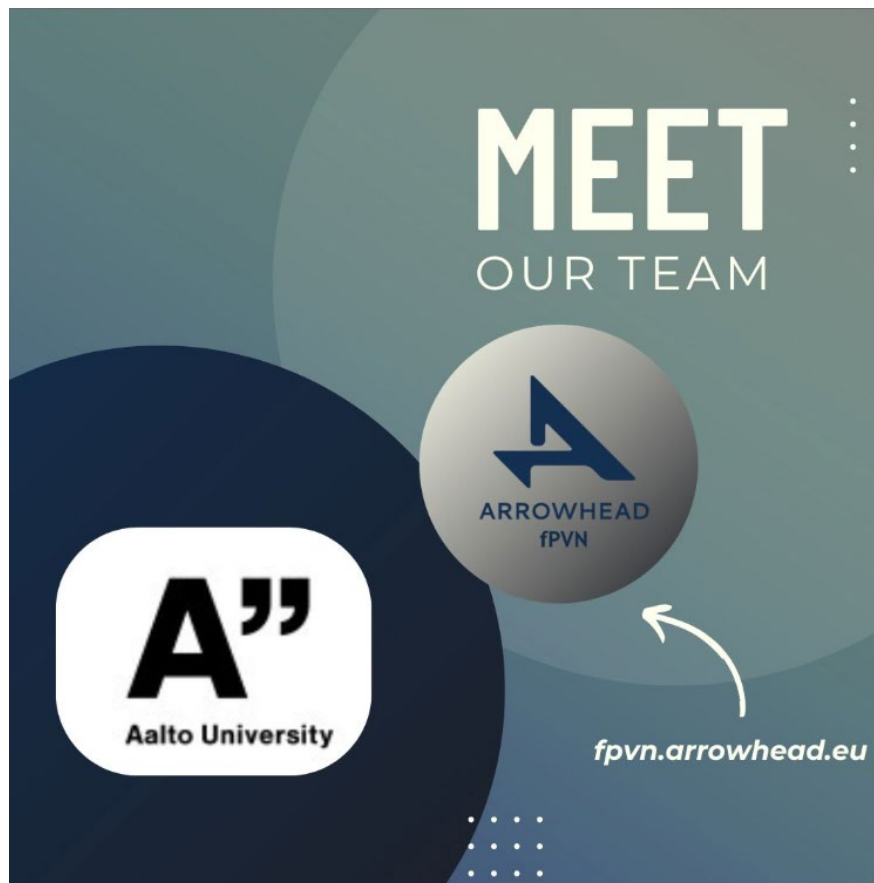


Figure 14: Arrowhead fPVN visual

2.7.2 Arrowhead fPVN Blog

Arrowhead fPVN partners had committed to contribute to the project's blog so that the project's progress and the consortium work could be communicated to the Arrowhead fPVN target audiences. The Arrowhead fPVN blog was updated with informative yet easy-to-read

articles. The blog articles are available on the website.



Figure 15: Arrowhead fPVN blog

2.7.3 Arrowhead fPVN Training Sessions

These videos presents trainings as a key mechanism for knowledge transfer and capacity building within the project. These sessions are designed to equip participants with both theoretical understanding and practical skills related to the project's technologies and methodologies. The trainings focus on topics such as system interoperability, use of the Arrowhead Framework, and integration of industrial applications, ensuring that stakeholders can effectively apply project results in real-world scenarios. Overall, they support the adoption, scalability, and long-term impact of the project by empowering partners and external audiences with hands-on expertise.



Figure 15: OBI Training

2.7.4 Arrowhead fPVN Pilot Use Cases

- **UC 1.6 – Industrial Data Integration and Interoperability:** This use case focuses on enabling seamless data exchange between heterogeneous industrial systems. It demonstrates how service-oriented architectures and microservices can support interoperability across different platforms, improving system flexibility and integration efficiency in complex production environments.
- **UC 1.7 – Cross-System Communication and Automation:** UC 1.7 addresses the challenge of connecting distributed industrial components through standardized interfaces. It highlights automated data flows and orchestration mechanisms that allow systems to interact dynamically, supporting more efficient and adaptive manufacturing processes.
- **UC 1.9 – Advanced Interoperability in Industrial Ecosystems:** This use case builds on interoperability by integrating semantic translation capabilities. It enables systems with different data models to understand each other, supporting more scalable and resilient industrial ecosystems where data can be reused across domains.
- **UC 2.6 – Industrial System Integration and Performance Optimization:** UC 2.6 demonstrates the integration of multiple services into a unified architecture, focusing on improving operational performance. It shows progress in technical readiness and highlights the transition from concept to more mature, deployable solutions.

- **UC 2.7 – Aircraft Health Management System:** This use case applies Arrowhead technologies to the aviation domain, enabling real-time monitoring and management of aircraft systems. It leverages microservices and interoperability mechanisms to improve predictive maintenance, safety, and operational efficiency.
- **UC 2.9 – Digital Twins for Enhanced Industrial Performance:** UC 2.9 focuses on the use of digital twins to simulate and optimize industrial processes. By combining real-time data with virtual models, it enables better decision-making, predictive capabilities, and performance optimization across production systems.
- **UC 3.9 (Engineering Supplier Service) – Interoperability in Engineering Projects:** This use case addresses interoperability in complex engineering and supplier ecosystems. It supports the exchange of technical information between stakeholders involved in investment projects, improving coordination, reducing errors, and enhancing collaboration across the value chain.
- **UC 3.9 (Legacy P&ID) – Integration of Legacy Engineering Data:** This variant of UC 3.9 focuses on integrating legacy systems, particularly P&ID (Piping and Instrumentation Diagrams), into modern digital environments. It demonstrates how existing industrial assets can be connected and reused within new interoperable architectures, preserving value while enabling digital transformation.

2.8. Dissemination and communication strategy

The Arrowhead fPVN dissemination and communication strategy is designed as a key enabler for maximising project impact, visibility, and long-term sustainability. It supports the effective transfer of knowledge, promotes stakeholder engagement, and facilitates the adoption of project results across industrial, academic, and societal domains.

2.8.1 Objectives

The main objectives of the dissemination and communication strategy are to:

- Ensure the systematic collection, structuring, and dissemination of project results, including technological developments, standardisation outcomes, and lessons learned
- Raise awareness of Arrowhead fPVN innovations in interoperability, digital transformation, and industrial automation
- Support the uptake and exploitation of project outcomes by relevant stakeholders
- Contribute to standardisation activities and align project results with industrial frameworks
- Foster knowledge transfer and capacity building across industry and academia

These objectives reflect the need to promote a novel interoperability approach in traditionally conservative industrial sectors, requiring targeted efforts to drive awareness and adoption.

2.8.2 Strategic Approach

The dissemination strategy follows a holistic and integrated approach, closely aligned with the project's technical progress and industrial validation activities. A key principle is the strong linkage between dissemination and pilot use cases, ensuring that all communication activities are grounded in validated, real-world results. This approach enhances credibility and supports the practical adoption of Arrowhead fPVN solutions.

The strategy also emphasises a transition from:

- Awareness-building in early project phases,
- Engagement, validation, and exploitation in later stages

This evolution ensures alignment with the project lifecycle and maximises the impact of dissemination activities.

2.8.3 Target Groups

The dissemination activities address a broad range of stakeholders, including:

- Industrial stakeholders (manufacturers, system integrators, SMEs)
- Research and academic communities
- Standardisation bodies and policy makers
- Technology providers and developers
- Wider societal actors interested in digital transformation

This multi-stakeholder approach ensures that both technical and non-technical audiences are effectively reached.

2.8.4 Communication Channels and Tools

The strategy adopts a multi-channel communication approach, combining:

- Project website and digital platforms
- Social media channels and online campaigns
- Scientific publications and technical articles
- Workshops, conferences, and industry events

- Training materials and knowledge-sharing activities

All partners actively contribute to dissemination, ensuring broad outreach, domain-specific expertise, and consistent messaging across all activities.

2.8.5 Key Communication Principles

The dissemination strategy is guided by several key principles:

- Technology-driven communication: promoting the Arrowhead ecosystem as a unified technological framework rather than focusing on individual projects
- Value-oriented messaging: clearly highlighting business benefits such as efficiency, scalability, and cost reduction
- Use-case-driven storytelling: leveraging concrete industrial scenarios and customer cases to demonstrate real impact
- Modern and forward-looking communication: adopting a strong visual identity and engaging communication style

Additionally, efforts are made to strengthen visibility through targeted messaging, structured content creation, and active use of digital engagement tools.

2.8.6 Coordination and Implementation

Dissemination activities are coordinated at project level and implemented collaboratively by all partners. This ensures:

- Alignment with technical developments and project milestones
- Continuous monitoring of progress through KPIs
- Adaptation of activities based on feedback and emerging opportunities

The integration with other work packages enables effective dissemination of both technical results and industrial outcomes, ensuring coherence across the project.

2.8.7 Conclusion

The Arrowhead fpvn dissemination and communication strategy provides a comprehensive, structured, and impact-oriented framework. By combining strong coordination, multi-channel communication, and a clear focus on industrial validation and value creation, the strategy

ensures that project results are widely visible, effectively communicated, and sustainably adopted beyond the project duration.

2.9. Open Science

The Arrowhead Flexible Production Value Networks (Arrowhead fPVN) project follows an Open Science approach that promotes transparency, accessibility, collaboration, and reproducibility of research results throughout the project lifecycle. In line with Horizon Europe principles, the project supports the early and open sharing of scientific and technical knowledge through publications, technical reports, open dissemination activities, and publicly accessible digital communication channels.

A key element of the project's Open Science strategy is the use of the dedicated Arrowhead fPVN Zenodo Community, which serves as a centralized repository for publications, deliverables, presentations, reports, dissemination materials, and other research outputs. This ensures long-term accessibility, traceability, and preservation of project results while supporting open access to scientific and technical knowledge generated during the action. Whenever possible, project partners are encouraged to share publications through pre-prints and open-access dissemination channels to accelerate knowledge exchange within the research and industrial communities.

The project also promotes open and collaborative dissemination through newsletters, webinars, workshops, training activities, and technical demonstrations. The Arrowhead fPVN YouTube channel further supports Open Science practices by providing publicly accessible training sessions, technical presentations, pilot demonstrations, tutorials, and explanatory videos related to the project technologies, methodologies, and industrial use cases. These materials contribute to broader knowledge transfer, facilitate stakeholder engagement, and support the adoption of the Arrowhead ecosystem across different industrial sectors.

To ensure reproducibility and transparency of the obtained results, the project places strong emphasis on documentation, standardized methodologies, technical reporting, and validation procedures. Research outputs, pilot implementations, and technical demonstrations are accompanied by detailed descriptions of the applied methods, architectures, interoperability mechanisms, datasets, and validation approaches whenever possible. The use of open standards, microservices architectures, interoperable information models, and documented integration procedures further contributes to the reproducibility of the project outcomes.

In addition, the project supports reproducibility through the sharing of technical materials, implementation guidelines, training content, demonstration videos, and best practices across the consortium and external stakeholders. Dissemination activities are designed not only to communicate results, but also to enable other researchers, industrial partners, and technology adopters to understand, replicate, validate, and further develop the approaches and technologies generated within Arrowhead fPVN.

2.10. Key Performance Indicators

Communication/ Dissemination Means	Success Indicators	Target Values	Results achieved	Timeline
Project Website	Search Engine Optimization metrics	Online by month 1; Unique visitors from M12: 1000; from M36: 2000	2000	Ready by M1; M1-M36
Social media	#of users/ followers	LinkedIn >200 followers;	319 – LinkedIn	M1-M36
Newsletters	# of publications	Newsletters: >3	4	M1-M36; 1 Newsletter per year
Video Clips	# of video clips and views	Number of online video clips: >3; Number of video views: > 500	96 clips 296 subscribers	By M36
Factsheets/ Brochures	# of factsheets and hardcopies	Technical factsheets: 3; Non-technical factsheets: 3; Hardcopies: > 1000	Technical factsheets: 7 Non-technical factsheets: 1 Hardcopies: >100	M1-M36
Flyers/ Posters & roll-ups	# of flyers and banners	Project flyers: >3; Posters & roll-up banners: >3	Project flyers: 1 Posters & roll-up banners: 10	M1-M36
Industrial exhibitions	# of exhibitions	Participation in industrial exhibitions, trade fairs: >10	14	M7-M36

Scientific publications	#of publications	Journals/magazines >10; Conferences >20; Conference demonstrations: >6	11 30 6	M7-M36
Training	# of trainings over the course of the project	Online training tutorials: 3 Number of PhD schools: 2; Webinars: 2	34 3 18	M7-M36
Online Repository	Deliverables accepted by the European Commission	Number of publicly available deliverables: > 19	12	M1-M36
Networking	Engage in European and international networks for Interoperability	Participate in workshops and seminars > 15	15	M6-M36

3. Standardization Activities

3.1 Standardization Landscape overview

Arrowhead fPVN in cooperation with AIMS5.0 has developed the Arrowhead DSL for SysML and its implementation into the Eclipse Papyrus tool. This work has been successfully presented at the OMG TEchnology Meeting in Reston April 2026. The Arrowhead DSL for both SysML v1.6 and SysML v2 was very well received. OMG requested further input particularly regarding sequence diagrams and library of Arrowhead core and support systems.

Arrowhead fPVN as a project has an official liason with ISO. And an active contribution to the ISO Standard library where ISO 10303, ISO 15926 and the new Ontology standard ISO 23726-2 IDO Industry Data Ontology have been used and updated. As an example, the ISO 15926-4 have got a new set of reference data from the Pulp & Paper industry. More than 900 classes and attributes have been added and prepared for next revision of ISO 15926-4 (ed5) One example is that 484 used Media codes in the Pulp & Paper industry in Sweden, source SSG 7650 have been added. The contribution of classes and propertys have also been done into the CFIHOS + environment at Posc Caesar Reference Data Cloud.

There have also been parallel activities with Arrowhead fPVN project inside Posc Caesar to make the standards ISO 15926 and ISO 23726 easier accessible and available on the Pocs Caesar (PCA) Reference Data Cloud.

Another outcome of the Arrowhead project is the cooperation with DISC project in Norway and Digitala Stambanan Phase 2 in Sweden. There have been several meetings and standard developing activities in the Norwegian DISC project to use the knowledge in Arrowhead fPVN to add value into the Norwegian continental shell development. In Sweden the Digitala Stambanan Phase 2 actively contribute with three use cases in the development of ISO 23726-3. In Digitala Stambanan Phase 3 the focus has been on culture change in industry and how reference data could provide better information exchange. We are still struggling with understanding how modern way of working could change the daily work in industry. But we see that better knowledge and usage of digital standards as ISO 15926, ISO 10303, ISO 23726, DEXPI and CFIHOS start moving the way of working in right direction.

In WP3 the focus has been on major industrial data models and that work has been successfully corporation between WP3 and WP4 about AFO: Arrowhead Framework Ontology. AFO was developed as a WP4 prototype and subsequently incorporated into WP3. There has also been done initial alignment work with IDO as upper ontology.

The focus of the WP3 has been to support the Industrial Use cases with updated standards and data models but the project has also shown that as an example the ISO 10303 standard could be transformed from STEP Core content into OWL 2. There has also been more work in aligning standards to each other

In WP 4 - Automated data model translations the work has been focused on four tasks.

- Task 4.1: Ontology-based Translation
- Task 4.2: ML/AI translation
- Task 4.3: Model-based translation
- Task 4.4: Dataset and translation quality assessment

The purpose has been to research, design, develop, and deploy autonomous translation solutions supporting translation between designated standardised data models.

WP6 – Automotives. Addresses interoperability challenges in industrial environments through two complementary use cases.

- Task 6.1 focuses on data interoperability within the EV battery lifecycle, particularly aiming at improving battery test lab management and lifecycle optimization. ML-based translation workflows and data interoperability exploration across battery lifecycle stages
- Task 6.2 addresses human-machine interaction (HMI), specifically enabling speech-based interaction in noisy industrial environments. WP2 microservice paradigm was implemented through the development of a modular API

WP7 – Aerospace. The focus has been on Standard S5000F and how it provide to ensure consistency, interoperability, and standardized information exchange

WP9 has had a need to add new classes and properties into the reference Reference Data Library for ISO 15926-4 and CFIHOS. That work has been done during spring 2026 and will continue after the Arrowhead fPVN project ends. Arrowhead has contributed with added reference and classes to the ISO 15926-4 and CFIHOS Reference Data Library (RDL) as CFIHOS +. The work has been added to the new Posc Caesar Reference Data Cloud Service mentioned above. One positive thing about adding content into Posc Caesar service is also that PCA has a unique agreement with ISO to be a maintenance agency for the ISO 23726 OBI / Ontology Based Interoperability. The same arrangement is made according to ISO 15926-4.

To reach the Posc Caesar Reference Data Cloud Service in the picture below you use [Link to the service](#)

Our collections

 Posccaesar Metadata Ontology 15 elements 0 sub collections	 CFIHOS RDL v.2.0 8570 elements 0 sub collections	 ISO 15926 Part 4 - edition 4 17367 elements 0 sub collections	 IMF Type Library 2781 elements 0 sub collections
 DISC 2025 Show and Tell 0 elements 1 sub collections	 Prod backup ontology 0 elements 0 sub collections	 Digital Engineering Symbol Ontology 21 elements 1 sub collections	 Industrial Data Ontology 147 elements 1 sub collections

[See All](#) ▾

Fig. 16 ARROWHEAD fPVN Project Factsheet

3.2 Applied standards in each use case category

Automotive (WP6):

- ASAM-ODS, ISO-IEC 25012

Aerospace (WP7):

- ISO 10303-239 and 242, S5000F, S2000M, S3000L, IPC 2581

Process industry (WP9):

- DEXPI, DEXPI+, CFIHOS, ISO 15926-2 and 4, ISO 18101, IEC 61987, IEC 61131-3, ISO 81346-1, ISO 10303-239 and 242, ISO 12006, ISO 19650, ISO 61499, OPAF, OPC UA, Peppol

WP3 Major standardized data models has cooperated with several standards organizations:

- ISO/TC 184/SC 4 Industrial Data, see <https://www.iso.org/committee/54158.html>. SC 4 is responsible for three standards that are used in AfPVN:
- ISO 10303: Industrial automation systems and integration - Product data representation and exchange
- ISO 15926: Industrial automation systems and integration - Integration of life-cycle data for process plants including oil and gas production facilities.
- ISO 23726: Automation systems and integration - Ontology based interoperability.
- DEXPI – Data Exchange in the Process Industry, see <https://dexpi.org/>
- CFIHOS – Capital Facilities Information Handover Specification, see <https://www.jip36-cfihos.org/>

- OMG – Object Management Group, see <https://www.omg.org/>
 - SysML v2 (Systems Modeling Language)
- IEC/TC 65 Industrial-process measurement, control and automation.
https://www.iec.ch/dyn/www/f?p=103:7:611090258625705::::FSP_ORG_ID:1250

IEC/TC 65 is responsible for one standard that are used in AfPVN:

- IEC 63278 Asset administration shell (AAS)
- CEN/CLC/JTC 24 Digital Product Passport – Framework and System.
- AfPVN <https://arrowhead.eu/>
- AFO: Arrowhead Framework Ontology
- DISC/PCA DISC project
- IMF: Information Modelling Framework

WP3 has made a large work to include and align different industry standards to make them transparent and possible to be used side by side. The main topic of the report is listed below. For more detailed information read the report.

Data model foundations:

ISO 15926	S5000F
ISO 15926-2: Data model	S3000L
ISO/TS 15926-4: Core reference data	S2000M International Specification for Material Management
DEXPI	ISO 10303-239 Product Life Cycle Support
DEXPI+	ISO 18101
ISO/IEC 81346-1	OPAF
CFIHOS	ISO 10303-242
IEC 61131-3	ISO 19650 Common Data Environment CDE
IEC 61987	IFC – Industry Foundation Classes
IEEE 1451	IEC 61499
IEC 61850	ISO 12006 – Building construction
IEC 62351	ISO/TS 4398:2022
ISO 23726-3 Industrial Data Ontology (IDO)	ASAM-ODS
	ISO-IEC 25012

Data representation formats/ Communication protocols:

- CoAP
- MQTT
- Diameter
- HTTP
- HTTP2

Modeling and knowledge representation languages:

- SysML
- OWL
- Commonalities
- Comparison analysis
- ISO 10628 vs. DEXPI
- ISO 15926 vs. ISO 10303
- ISO 15926 vs. ISO 81346

3.3 Digital Product Passport – DPP

During the Arrowhead fPVN project the European Commission established the ESPR - Ecodesign for Sustainable Products Regulation where the Digital Product Passport is one of the Key elements. Because of the parallel process and development of the DPP Standards that are listed below the project haven't got the chance to explore all details about the impact on Standardization Landscape that the project have got focus on. But in Arrowhead fPVN there have been partners that have been involved in the CEN JTC24 working groups and of that reason have got the opportunity to inform and reflect on how the use cases will be changed if the DPP standardization have been mandatory during the project time. Now the DPP standards will be officially launched 2026-05-28.

The background is to set harmonized Ecodesign requirements applicable throughout the single market helps boost the uptake of sustainable products, production and consumption. Ecodesign requirements are effective in reducing the environmental, energy and climate impacts of products and energy consumption and in improving circularity. DPP will include almost every product except medicine and food that's sold in Europe.

The final standards from the eight modules will end up in a unique standard in early beginning of 2026, first quarter. Drafts for the standards are now done and the work on finalized them are ongoing during the rest of 2025.

There are eight standards that are developed and they are listed below. The next phase in the DPP implementation is that on each product group there will be an Dedicated Act that define the special demands that a specific product group will have. The first Dedicated Act to be launched is on Batteries for EV vehicles and large energy plants (big batteries).

DPP: Digital product passport standards

- EN 18216: Digital product passport - Data exchange protocols
- EN 18219: Digital product passport - Unique identifiers
- EN 18220: Digital product passport - Data Carriers
- EN 18221: Digital product passport - data storage, archiving, and data persistence
- EN 18222: Digital Product Passport - Application Programming Interfaces (APIs) for the product passport lifecycle management and searchability
- EN 18223: Digital Product Passport - System interoperability
- EN 18239: Digital Product Passport - access rights management, information system security, and business confidentiality
- EN 18246: Digital product passport - Data authentication, reliability and integrity

3.4 Conclusion

WP3 provides a report about the major standardized data models, describing the key properties of the predominantly applied, uses case-related standards.

The delivery includes a survey result, key properties, scope and limitations of the collected standards, a summary about communication protocols, and comparisons.

It provides an overview of the currently applied data model standards. As an additional benefit of this document, the use-case participants can identify common issues and solutions based on the comparison results.

The document answers the following objectives of WP3:

- Select major standardised data models relevant to the use cases.
- Identify the foundational properties of the selected data models.
- Identify similarities and dissimilarities between the standardised data models.

This standardization activity has already made an impact in the steel industry. The PRIMSA project was granted by the RFCS EU unit and started April 2025. Here Europe's four largest steel plant builders, Tenova, Danieli, SMS and Primetal cooperate with Estelle makers like Tata steel, Orimartin, Salsa and ADS with the ambition to create the Unified Environmental Data Model, UEDM. The UEDM will be based on the IDO and using results from WP2, WP3 and WP4 of Arrowhead fPVN. Further more it worth mentioning that LTU on request from the steel industry coordinate the PRIMSA project.

4. Innovations' Catalogue

The Arrowhead fPVN Innovations' Catalogue is a central, living knowledge hub that documents, structures, and showcases how the Arrowhead Framework and related technologies are applied in real industrial contexts. Its purpose is not simply to list project outputs, but to make Arrowhead-based innovation understandable, discoverable, comparable, and reusable for both internal project partners and external stakeholders.

Introduced conceptually in D11.1, operationalised in D11.2, and matured in D11.3, this catalogue evolved from a planned dissemination tool into a strategic dissemination and exploitation instrument for Arrowhead-based solutions.

4.1 Architecture and Technical Background

The Innovations' Catalogue is built on top of the IoT-Catalogue.com and organised under a dedicated Arrowhead Initiative, aggregating information on Arrowhead-based projects, use cases and technological assets from both Arrowhead fPVN and earlier European initiatives.

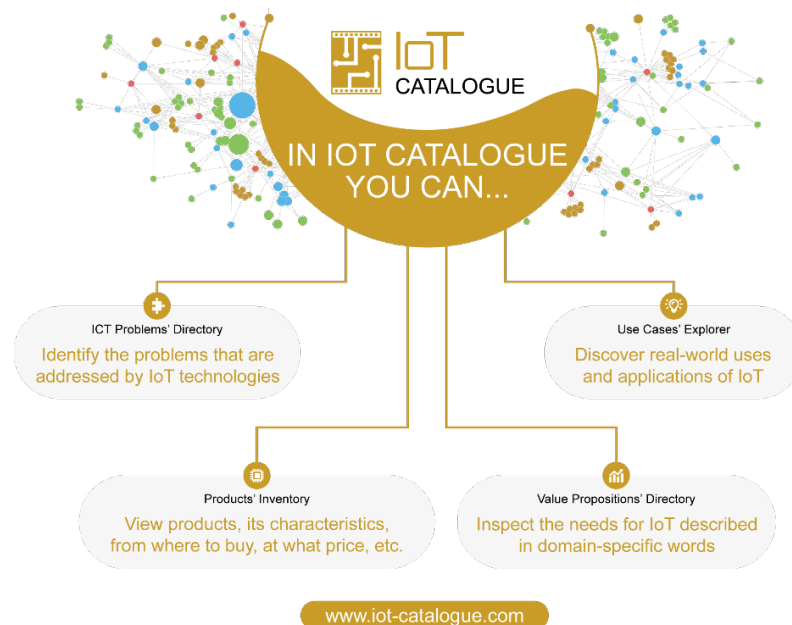


Figure 17 IoT-Catalogue content diagram

The IoT-Catalogue.com has an established way of modulating its content. It has a specific data model to describe and characterize use cases and technological assets. By providing a common data model and rich visualisations, this catalogue enables stakeholders to inspect solutions built on the Arrowhead Framework, analyse performance and impact, and identify component reuse and cross domain synergies. Content is curated through contributions from project partners and integrated via the IoT-Catalogue, which is also optimised for third-party integration, namely the

Arrowhead website , making it a living, extensible reference for Arrowhead based digital innovations and their real world value.

In D11.1 - Dissemination and standardisation plan, the plan for developing the Arrowhead fPVN Innovation Catalogue, a structured and interactive showcase of the project's results aimed at supporting dissemination, exploitation, and internal knowledge sharing was presented. Furthermore, the relevant features of IoT-Catalogue are detailed, as well as the dedicated pages.

4.2 Disseminating Arrowhead Technologies

With the technical base established, the following step was to identify the relevant content to populate the catalogue. This means not only the Arrowhead fPVN results but also the connections to other projects where the Arrowhead Framework is used.



Figure 18 Innovations' catalogue content integration flow

From the start, this exercise highlighted connections with another project already available on IoT-Catalogue, KYKLOS 4.0. Furthermore, as it continued to be populated, more relations were found, for example the AI-REDGIO 5.0 project.

These relations are based on the Arrowhead Framework, the central component of the Arrowhead initiative that links multiple projects together by developing on top of this framework.

D11.2 - Dissemination and standardisation report Y1 reports on the initial implementation and use of the Arrowhead Innovations' Catalogue during year 1, focusing on the integration of the arrowhead technologies and relation with other projects.

4.3 Finding Arrowhead-related Use Cases

Having a platform populated with the relevant technological assets and their relation to the Arrowhead framework, the following step focused on the connection to where these technologies were deployed and validated, the use cases. The primary purpose is to make visible where, how, and by whom Arrowhead is used, enabling stakeholders to discover existing solutions, analyse application contexts, and identify reuse and synergy opportunities.

Having a platform like IoT-Catalogue supporting this catalogue ensures that the project's results as well all the Arrowhead connections beyond will live beyond the project's lifetime and will be continuously maintained. Additionally, as new projects are added in the future and there is a connection to the Arrowhead Framework, it will be showcased there.

D11.3 - Dissemination and standardisation report Y2 describes the maturation and consolidation of the Arrowhead Innovation's Catalogue during year 2, focused not only on populating the catalogue with project's results but also on highlighting the relation to use cases from other projects and, therefore, providing the complete view of Arrowhead related solutions established as the main goal.

4.4 Integration in the Arrowhead Website

Supported by IoT-Catalogue.com, Innovations' Catalogue is accessible through the Arrowhead website, using the following link, where you will find the page presented in Figure 3.

catalogue.arrowhead.eu



Figure 19 Innovations' catalogue page in the Arrowhead website

In this page, users can understand what can be found on the Innovations' Catalogue, the platform where it is integrated on and navigate to it to find all the solutions built around the Arrowhead Framework. When visiting the IoT-Catalogue.com page, users will land on the Arrowhead initiative page, where all the related projects, use cases and technological assets that relate to it. Specific visualisers allow users to understand relevant aspects like the relations, where the technologies have been deployed and the added value they bring, to name a few.

4.5 Arrowhead fPVN in Innovations' Catalogue

Included in the Innovations' Catalogue content are the Arrowhead fPVN results which, as of the delivery of this document consists of:

- All 7 use cases, presented in Table 1
- 8 technological assets, presented in Table 2

These numbers represent the content status of the Innovations' Catalogue at the time of delivery of this document

Table 1 - Arrowhead fPVN use cases

UC	Name	Link
6.1	Interoperable information along the full life cycle of EV batteries	url
6.2	Humans in the interoperable System	url
7.1	Interoperable intelligent management of production lines	url
7.2	AHMS for Trend Monitoring, Predictive Maintenance and Fleet Operations & Maintenance Simulation	url
9.1	Pump station engineering	url
9.2	Digital twins that enable higher performance by interoperability in pulp mills & carton board mills	url
9.3	Interoperability for technical information exchange in process industry	url

Table 2 - Arrowhead fPVN technological assets

Name	Link
PolyGIIoT	url
Eclipse Arrowhead Framework	url
CoSIM Arrowhead	url
Percepta	url
BatteryPass.eu	url
Electronic Component to IPC2581 Model Translator	url
Inventory Routing Problem Service	url
Eclipse Arrowhead	url

5. References

Deliverables D11.1, D11.2, D11.3

6. Conclusions

The dissemination, communication, and standardization activities have continued to be highly successful, building upon the robust plan initially released in D11.1 and further refined in D11.2. Evaluating the communication efforts conducted throughout Y1 and Y2, we can confidently assert that these periods have been exceptionally rewarding for the project. The brand image of Arrowhead fPVN has achieved significant scope and influence, attracting a larger user base and generating a higher-than-anticipated response across all channels. The Project has consistently engaged audiences by disseminating both technical material and strengthening its brand image, with the internet channel remaining a crucial instrument for executing the communication plan and social networks playing a vital role in driving traffic and boosting visitor numbers.

Looking ahead to the third phase of the project, Y3, the Consortium plans to maintain and intensify its proactive approach on social media and other online channels. Building on the established digital presence, Y3 will further leverage internet channels to drive engagement in offline activities, with a continued and heightened emphasis on participation in key industrial events. This comprehensive plan will be implemented in ongoing collaboration with the team, ensuring a truly successful and impactful year for Arrowhead fPVN.

7. Revision history

7.1. Contributing and reviewing partners

Contributions	Reviews	Participants	Representing partner
Table of Content	George Suci	Octavian Fratu, Cosmina Stalidi	UPB, Beia
Content contributions	George Suci	Alexandru Vulpe, Erik Molin, Louise Cassimiro, Simona Halunga, Eduard-Cristian Popovici, Seyed Salar Sefati, Inge Gavat, Theodor Pintilie, Svetlana Segarceanu, Cosmina Stalidi	UPB, Beia, SEIIA, UNP

7.2. Amendments

No.	Date	Version	Subject of Amendments	Author
1	2026-06-14	0.9	Follow internal review recommendations	Octavian Fratu

7.3. Quality assurance

No	Date	Version	Approved by
1	2026-06-14	1.0	Jerker Delsing