openZDM

OPEN PLATFORM FOR REALIZING ZERO DEFECTS IN CYBER PHYSICAL MANUFACTURING

D6.3 Impact management activities - final version

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Abstract	This deliverable presents the final overview of openZDM's impact management activities up to Month 42, covering communication, dissemination, exploitation, and standardisation activities. It summarises the project's outreach results, the final exploitable results, partners' exploitation plans, business feasibility findings across all pilot use cases, and the completed business plan and go-to-market strategy for the integrated platform. The document also reports the Horizon Results Booster outputs and the final IPR agreement, along with contributions to ZDM and AAS standardisation to support long-term adoption.
Keywords	Dissemination, communication, exploitation, IPR agreement, go-to-market strategy, standardisation, Zero-Defect Manufacturing, Horizon Results Booster
License	

Dissemination Level:	
PU	**Public, fully open**
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R	**Document, report (excluding the periodic and final reports)**

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Version History

Version	Date	Owner	Author(s)	Changes to previous version
0.1	2025-07-08	INTRA	INTRA	Initial draft template prepared; structure outlined.
0.2	2025-07-22	INTRA	INTRA	Added preliminary content for the exploitation section and initial list of Exploitable Results.
0.3	2025-08-19	INTRA	INTRA	Added market research section summarising EU manufacturing sector analysis and ZDM trends.
0.4	2025-10-29	INTRA	INTRA	Added partners' individual exploitation plans.
0.5	2025-11-11	INTRA	INTRA	Included business assessment survey results for the pilot lines.
0.6	2025-11-19	INTRA	INTRA	Added Horizon Results Booster outcomes (Module B & C workshops for KER1 – G3F and KER2 – openZDM platform).
0.7	2025-11-19	INTRA	INTRA	Added full business plan section.
0.8	2025-11-21	INTRA	INTRA	Included Communication, Dissemination and Standardisation activities.
0.9	2025-11-24	INTRA	INTRA, LMS, F6S, AIMEN	Final internal review; formatting, consistency check; ready for review.
1.0	2025-12-04	INTRA	INTRA, F6S, AIMEN	Final draft

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List of Abbreviations & Acronyms

AAS	:	Asset Administration Shell
D	:	Deliverable
DIH	:	Digital Innovation Hub
EPC	:	European Patent Convention
ER	:	Exploitable Results
GA	:	General Assembly
IIoT	:	Industrial Internet of Things
IP	:	Intellectual Property
IPR	:	Intellectual Property Rights
KER	:	Key Exploitable Results
KPI	:	Key Performance Indicator
NDI	:	Non-destructive inspection
SEO	:	Search Engine Optimisation
SDOs	:	Standards developing organisations
SME	:	Small and medium-sized enterprises
WP	:	Work Package
ZDM	:	Zero defect manufacturing

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Executive Summary

The underlying deliverable provides the final, consolidated overview of all impact management activities performed within openZDM up to Month 42, covering communication, dissemination, exploitation, business planning, and standardisation. The project implemented a strategy to maximise visibility and stakeholder engagement, with systematic monitoring against predefined KPIs. While some outreach indicators (such as the website sessions and YouTube views) proved ambitious, the consortium introduced corrective measures like website restructuring, Search Engine Optimisation (SEO), expanded content production, and intensified LinkedIn engagement. As a result, the project exceeded most KPIs related to impressions, newsletters, DIH outreach, public events, external blog publications, video production, and stakeholder liaison, demonstrating a strong and targeted presence across the European manufacturing ecosystem.

The deliverable also presents the final list of exploitable results (in total 18 items), including software components, Digital Twins, data analytics modules, and hardware Non-Destructive Inspection (NDI) systems. Each partner has documented individual exploitation intentions, identifying commercial, research, and strategic pathways for post-project utilisation. The analysis incorporates the outcomes from the Horizon Results Booster services for ER#6 (IIoT portable laser line triangulation for gap and flush - G3F) and the integrated platform, covering market definition, value proposition, risk mapping, and exploitation planning. A sustainability and business feasibility assessment was performed for the five industrial use cases (i.e., in automotive, steel, glass, wood-based panels, and EV battery manufacturing), confirming operational relevance, user interest, and a cost-benefit potential for some solutions. For instance, strong business validation comes from the automotive assembly, steel processing, and EV battery manufacturing use cases.

The deliverable includes the integrated platform's business plan, covering its value proposition, target markets, competitive landscape, governance structure, business model, sales and marketing strategy, and financial projections (5 years after the end of the project). It also outlines go-to-market scenarios and licensing models for both software and NDI hardware results. The openZDM platform will be offered as a joint licensable result, use-case-specific Service Bundle (combining the core AAS-based middleware, digital twins, analytics and optional NDIs) via annual software licensing agreements complemented by paid customisation and integration services.

To support the post-project sustainability of openZDM, the openZDM IPR agreement has been designed, clarifying ownership, background IP, licensing conditions, and joint exploitation rules. Last, openZDM has contributed to Standardisation; particularly in Zero Defect Manufacturing and the Asset Administration Shell modelling areas. Contributions to both areas are documented to support industrial adoption and alignment with emerging EU digital manufacturing frameworks.

1. Introduction

1.1 Scope and Objectives

This deliverable presents the final and consolidated progress of the impact management activities implemented in the openZDM project up to Month 42, covering the full lifecycle of communication, dissemination, exploitation, and standardisation activities. As the concluding report under Work Package 6, it documents how the consortium positioned the project's Zero-Defect Manufacturing (ZDM) solutions within the European manufacturing ecosystem, ensuring broad visibility, stakeholder engagement, and a pathway for post-project sustainability and adoption. The work builds upon the foundations laid in D6.1 (initial version) and D6.2 (intermediate version), expanding them with final KPIs, refined exploitation plans, updated business modelling, and the completed IPR agreement to support the reuse of the project's 18 Exploitable Results (ER).

Hence, in this framework, the scope of the deliverable is threefold. First, it reports the final communication and dissemination achievements, including website performance, social media outreach, participation in industrial and scientific events, preparation of communication assets, and engagement with Digital Innovation Hubs and external projects. Second, it provides an exploitation analysis, presenting the final list of exploitable results, ownership and background IP mapping, partner-specific exploitation intentions, and the complete business plan for the openZDM integrated platform. The deliverable also reports the outcomes of the Horizon Results Booster (Modules B and C), which analysed the customer profiles, value propositions, and go-to-market strategies for the openZDM platform; on top of that, a market analysis is also part of the current deliverable. Third, it reports the standardisation activities carried out in the project, including contributions to CWA 18230:2025 on ZDM, advancements to AAS-related standardisation, and proposed updates to machine vision terminology in the ECLASS dictionary. Finally, this deliverable analyses the business feasibility and industrial impact across the five openZDM use cases (i.e, automotive assembly, steel processing, glass manufacturing, wood-based panels, and EV battery production).

The deliverable objectives are as follows.

- **Report the final communication and dissemination achievements**, assessing KPIs and outreach effectiveness.
- **Consolidate exploitable results**, including ownership, maturity, and partner exploitation intentions.
- **Define the joint exploitation strategy, business model, governance, and service-bundle** offering of the openZDM platform (and some selected ZDM solutions).
- **Present Horizon Results Booster outcomes** and refine market positioning, value propositions, risks, and go-to-market pathways.
- **Document standardisation contributions** and assess business feasibility across the five industrial pilot use cases.

1.2 Structure of the document

The document is structured into five main sections. It begins with an introduction outlining the scope, objectives, and overall framework for impact management.

- **Section 2** presents the final communication and dissemination activities (related to Task 6.1), including tools, channels, KPIs, and outreach performance.
- **Section 3** delivers the core exploitation content (related to Task 6.2), detailing the updated IPR and ownership arrangements, the final list of exploitable results, individual partner exploitation plans, the Horizon Results Booster outcomes, the business feasibility assessment of all five industrial use cases, and the complete business plan and go-to-market strategy for the openZDM integrated platform.
- **Section 4** reports the project's contributions to standardization (related to Task 6.3), particularly in Zero-Defect Manufacturing and AAS modelling, highlighting how these activities support wider industrial uptake.
- The document concludes with **Section 5**, which summarises the main WP6 (impact enhancement) outcomes and provides the final reflections on sustainability and future integration opportunities of the openZDM platform with other EU initiatives.

The current version of the deliverable constitutes the 'Public' and 'Non-sensitive' version of D6.3. However, given that many exploitation/ business planning related activities were classified as confidential information, a 'private' and more elaborate version is also available, including the full set of details about the partners' exploitation views,

business models, governance structures of the integrated openZDM platform, go-to-market strategies and the IPR agreement provisions. This 'private' version is available only internally and for project reporting purposes.

1.3 Impact Management activities overview

The impact management strategy of openZDM followed a three-stage approach (i.e., Market Awareness (M1–M18), Market Positioning (M18–M36) and Market Outreach (M36–M42)) so that communication, dissemination, exploitation and standardisation activities were closely coordinated to maximise the project's visibility and adoption potential (Figure 1). **Market Awareness (M1–M18)**: In the early stages, the consortium established the visual identity, communication strategy and outreach channels required to build some recognition around the project. The openZDM website, social media channels and press releases acted as the main vehicles for awareness creation. During this phase, the first exploitation activities were initiated. Phase 1 and Phase 2 of the exploitation plan involved identifying the exploitable results, mapping their industrial relevance. This allowed the consortium to classify each result as a stand-alone asset or part of an integrated platform offering, which laid the ground for the service-bundle business model followed eventually by the openZDM platform. Also, cooperation with other EU initiatives and clusters also began, strengthening alignment with broader digital manufacturing efforts. **Market Positioning (M18–M36)**: The second phase focused on positioning the openZDM outcomes within the EU manufacturing landscape. Dissemination activities intensified via conference participation (ETFA, ADRF24), industrial fairs (AUTOMATICA), workshops and white papers, showcasing the project's Digital Twins, analytics, NDIs and AAS-based interoperability innovations. Phase 3 and Phase 4 of the exploitation plan covered IPR management, background/foreground analysis, and joint exploitation strategies for selected project solutions. **Market Outreach (M36–M42)**: Dissemination efforts were guided toward large industrial events, stakeholder demonstrations and sector-oriented communication. The consortium showcased tested platform components, pilot success stories, demonstration videos and validated analytics results to build credibility and stimulate early demand. At this stage, Phase 5 and Phase 6 of the exploitation plan were executed. A refined business model and exploitation roadmap were finalised, guiding commercialisation via a service-bundle model, where each bundle (Automotive, Steel, Glass, Wood, EV Batteries) integrates Digital Twins, NDIs, analytics and the AAS middleware under a licensing agreement as a software offering. The consortium finalised the platform governance model, defining partner roles across design, operations, sales and communication. At the same time, the Horizon Results Booster workshops played an important role in strengthening the market narrative, refining customer profiles, identifying early adopters and defining the full value proposition for both the integrated platform and the NDI solutions.

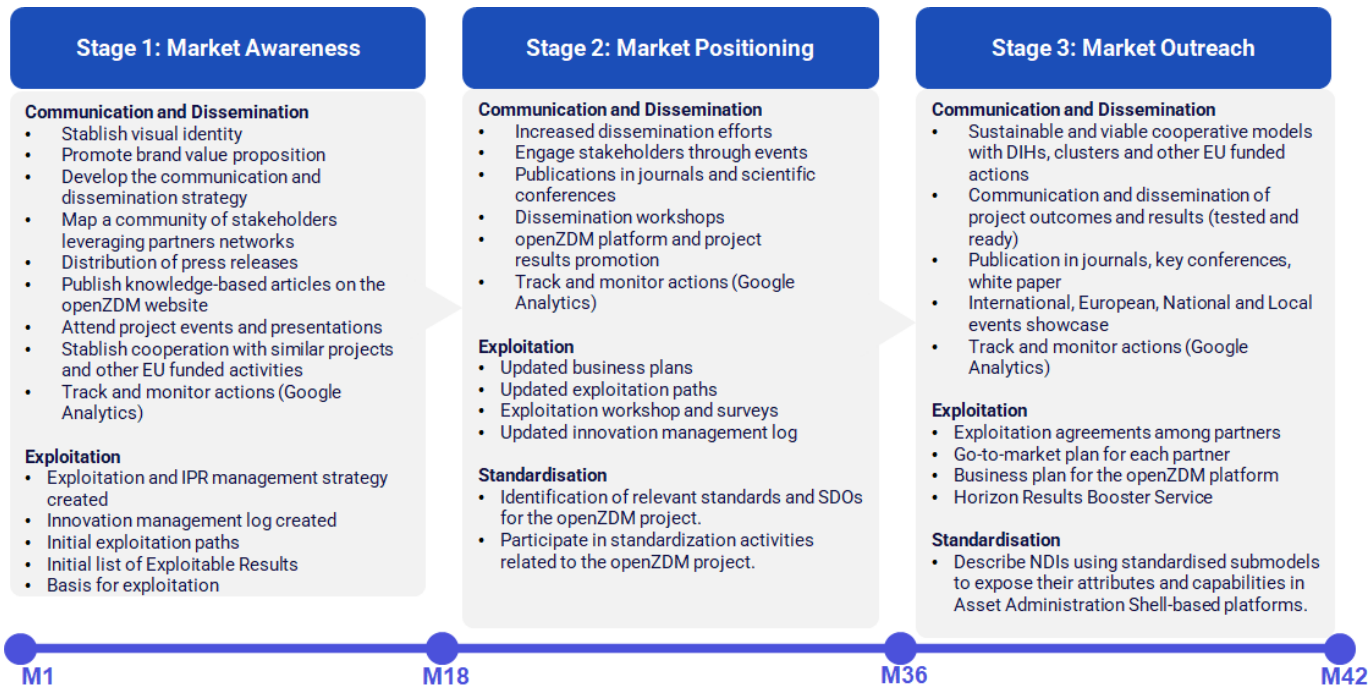


Figure 1: openZDM Impact Assessment Activities Overview

2. Final update on the openZDM Communication and Dissemination Activities

Since the launch of openZDM, the focus on delivering high quality activities for Communication and Dissemination was a priority with the goal of building a broad understanding and engagement with our Zero-Defect Manufacturing (ZDM) approach. All consortium members were aligned with the project strategy and engaged to implement actions to boost awareness, attract key stakeholders, and involve a wider non-technical audience. The Communication and Dissemination strategy for Impact Management activities, implemented throughout the entire project lifetime, was designed and shared on the deliverable D6.1 - Plan for impact management activities – initial version. In this report, the project outlines an integrated view for communication, dissemination, and exploitation concepts aimed at maximising openZDM outcomes and results. This plan was created under these pillars: targeted stakeholders; communication & dissemination activities; communication and dissemination tools and channels; exploitation plan and IPR strategy; and impact assessment. As reported on D6.2 - Impact management activities - intermediate version, openZDM was able to deliver continuous efforts during the project's three phases of market awareness, market positioning, and finally market outreach. D6.2 outlines the work conducted mid-term of the project. In this report, the focus is given to the final phase of the market outreach for openZDM, where the communication and dissemination activities were dedicated to shedding light on the expansion of reach and visibility of the project until its conclusion. A set of data is detailed in the upcoming sub-sections, demonstrating the success of this goal.

2.1 Communication activities

Throughout the project lifecycle, the communication team executed a comprehensive strategy aimed at maximising the visibility, engagement, and potential adoption of the openZDM Zero-Defect Manufacturing (ZDM) paradigm. These targeted efforts have successfully fostered widespread understanding and uptake potential for our innovative framework, positioning the openZDM solution as a sustainable manufacturing solution within the European manufacturing ecosystem. The success of these actions against the defined objectives is detailed through the analysis of our Key Performance Indicators (KPIs). The following overview provides a quantitative assessment of the communication strategy's overall reach and measurable impact on our targeted stakeholders, as summarised in Table 1.

Table 1: Overview of the communication activities and their status at M24 and M41.

Communication tools & channels	Communication activities	KPIs	Status [M24]	Status [M41]
Project website	Online project website designed and developed by F6S, updated throughout the project.	Website ready by M02 >7.000 visitors by M42	Website ready in M02 2069 visitors	Website ready in M02 3986 visitors
Social media channels	Online presence on social media channels such as LinkedIn, Twitter, spreading the news about the project.	>1000 stakeholders >200 monthly impressions	528 stakeholders 95,718 impressions	740 stakeholders 148265 impressions
Newsletters	Newsletters will be circulated via email lists providing an overview of the main project activities and outcomes.	>6 newsletters >1000 contacts reached	3 newsletters 117 contacts reached	7 newsletters 1032 contacts reached
Video Clips	Multimedia video podcasts presenting the project, its innovation, and its key outcomes.	>3 videos produced >2.000 views on YouTube	7 videos produced 443 views on YouTube	19 videos produced 1093 views on YouTube
Printed materials	Brochures, leaflets, flyers for events, roll-up banners, and posters, are also available online for printing through the project's website.	>2.000 printed copies distributed >4 roll-up banners/posters	610 printed copies distributed 5 roll-up banners/posters	800 printed copies distributed 8 roll-up banners/posters
Public events	Public events with public, schools and higher education	>4 public events	9 public events	15 public events

Communication tools & channels	Communication activities	KPIs	Status [M24]	Status [M41]
	institutions to inform them about the project and its impact on the everyday life.	>3 open days at schools >100 participants/event		5 open days at schools with 515 participants in total
Newspapers, magazines	Non-technical articles and press releases in local newspapers and magazines to reach a broader audience providing visibility of the project and its main achievements.	>3 press releases in newspapers and magazines	2 press releases 8 press release clippings	3 press releases 22 press release clippings
Digital Innovation Hubs (DIH)	Promotion of project results in various DIH to amplify the project's outreach for early adoption.	>30 DIHs contacted	To be started	215 DIHs contacted
Fora & Blogs	Promotion of periodic non-technical reports (publications) to fora and blogs to create awareness of the openZDM potential and features.	>5 publications to blogs >5 blogs/fora to post	Publications to externa blogs to be started 25 publications on owned blog	39 owned blog posts 10 external blog posts (mentions)
Other projects and activities	Liaison with other projects to coordinate the activities of openZDM considering the ongoing activities in other projects. For these reasons, liaison delegates will be identified.	>8 relevant projects to liaise	3 relevant projects to liaise	11 project liaisons and 3 clusters involvement

The data above was populated on 31st October 2025 – one month before the official end of the project (M41). An updated version of this table will be included in the final technical part of the periodic report with data until M42 of project implementation.

After analysis of the above-mentioned KPIs, we can conclude that the openZDM team has successfully concluded its communication activities, demonstrating a high level of commitment and effectiveness in promoting the innovative Zero-Defect Manufacturing (ZDM) platform. We are pleased to confirm that the project exceeded nearly all quantitative communication KPIs, including those for **social media impressions (1756%), number of newsletters (117%) and contacts reached (103%), the participation to public events (300%), multimedia asset production (475%), digital innovation hub contacted (694%), blog articles created (650%) and project liaisons established (167%)**. While certain targets, specifically website sessions, social media stakeholder count, and YouTube views, were not fully met, it is important to contextualise these ambitious goals within a project targeting a highly specialised niche within industrial manufacturing. However, to address these challenges, the consortium implemented substantial extra measures. For example, to boost website visibility, we rebranded the website and executed an SEO optimisation strategy. Moreover, to enlarge our social media followers base, we actively sought synergies with other relevant European projects, and developed more engaging content to attract a wider, yet relevant, industrial and research audience. Furthermore, to maximise the chance of meeting the video view target, the communication team massively over-delivered on production, creating 19 videos instead of the 2 originally targeted. These efforts confirm the consortium's absolute dedication to making the best possible and impactful outcome. We are confident that every possible avenue was utilised to disseminate the openZDM platform and its innovative results, successfully establishing a strong, technically engaged community poised to drive the future exploitation of the ZDM technology.

2.1.1 Communication tools and channels

2.1.1.1 Website

The openZDM project's dedicated website, established at openZDM.eu and fully operational by Month 2 (June 2022), served as the primary online hub for disseminating results and engaging stakeholders. While the initial target for overall visitor count proved ambitious, a detailed analysis of the final metrics reveals significant progress driven by concentrated efforts. It is important to address the methodological change in reporting: Google Analytics officially replaced Universal Analytics (UA) with Google Analytics 4 (GA4) on July 1, 2023. With this transition, the legacy metric of "visits" was retired. The current and accurate industry standard is "sessions", which represents a direct equivalent to the old "visit", quantifying a group of user interactions within a given timeframe. For this final report (registered during M41), the total figure of 3986 sessions was recorded. Figure 2 represents over 50% achievement of the initial target set in the Grant Agreement.

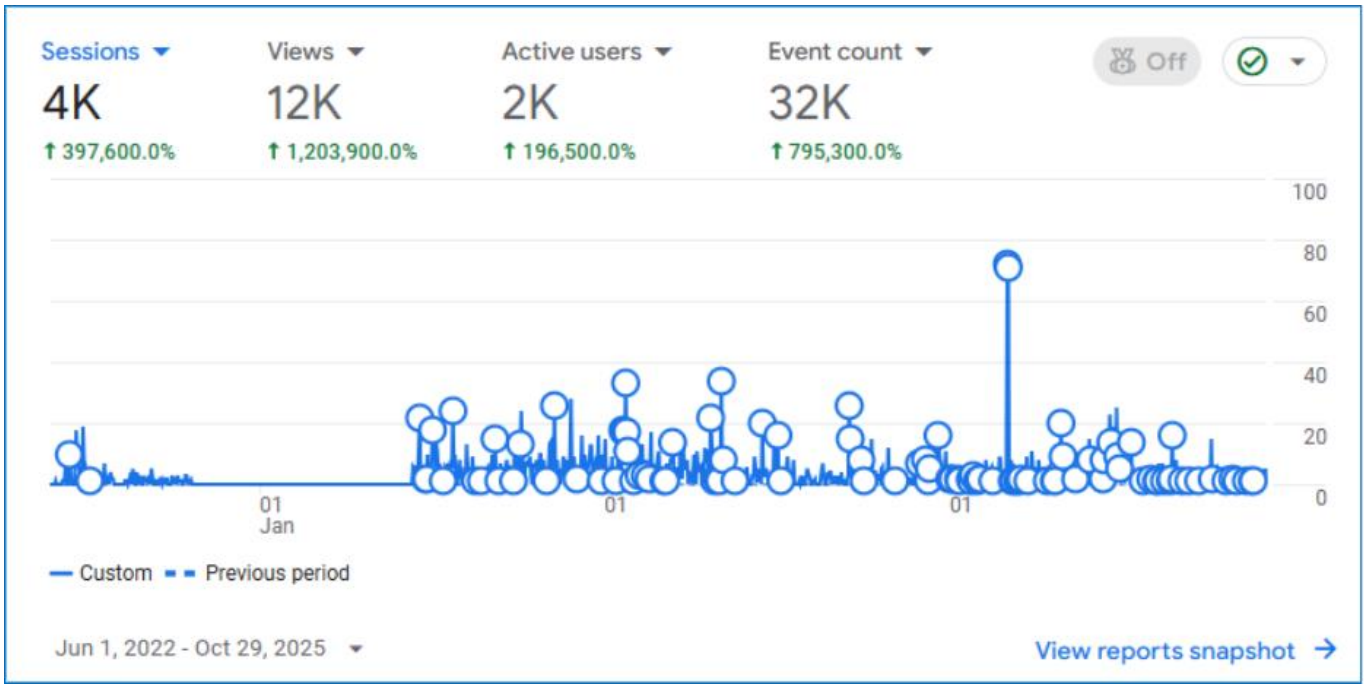


Figure 2: GA4 report (June 2022 – October 2025)

Utilising the GA4 measurement standard, the performance metrics from the beginning of the project until the end of M41 demonstrate strong stakeholder interaction with the platform's content and results. The number of 4K sessions represents the total number of initiated user visits to the website. This figure, a direct equivalent to the legacy 'visits' metric, confirms a level of inbound traffic and stakeholder attention to the openZDM project. The number of 12K views indicates the high level of user interest once on the site. A ratio of 3 views per session suggests that visitors were actively exploring multiple pages, likely navigating between the project overview, demonstrator descriptions, and technical documentation (e.g., the G3F or AAS architecture). The number of 2K active users signifies the number of unique individuals who genuinely interacted with the site. This metric is critical as it validates that half of the total sessions were driven by unique and engaged users, not repeated or accidental traffic. Finally, the number of 32K events captures specific user actions (e.g., resource downloads, video plays, external link clicks). This high number (an average of 8 events per session) demonstrates a very active user base that went beyond simple browsing, validating the quality and relevance of the published technical content. In summary, the GA4 data confirms a highly engaged audience. Although the total session count was challenging to achieve, the depth of interaction (Views, Active Users, and Events) proves that the right people were successfully directed to the platform and found the openZDM content highly valuable. Comparing this to the Month 35 data, which showed only 35% of the target achieved, the consortium's efforts in the final year yielded a substantial and impactful increase in traffic. The consortium deployed a multi-faceted and targeted strategy to accelerate visibility:

- Website redesign: A significant update to the website's branding, structure and content was performed at Month 28 to enhance user experience and better communicate the platform's core value.

- SEO optimisation: A detailed Search Engine Optimisation (SEO) process was applied starting at Month 30. This work was crucial for improving organic search rankings, leading to an increase in high-quality inbound traffic.
- Content production: Internal content efforts were scaled up. The KPIs related to publications to external blogs were overachieved by more than 100%, and the internal KPIs related to blog article creation (interviews and event dissemination specifically) were exceeded by a factor of five (>500%).
- Growth hacking: A strategic "growth hacking" approach was applied to maximise content impact and reach.

In Figure 1, we can notice that the highest website performance peak was in the last year of the project, after the implementation of these mitigation actions. These intensive efforts allowed openZDM to recover and significantly boost its website performance, ensuring a strong foundation for the post-project exploitation of the platform.

2.1.1.2 Social media

Social media channels proved highly effective in broadcasting the project's innovations and generating interest. As we navigated the final stages of the project, we made a strategic decision regarding our social media presence. The platform formerly known as Twitter underwent a turbulent transition to X, accompanied by frequent technical instabilities and unpredictable changes to its paid advertising models. These disruptions made it difficult to guarantee a stable return on investment or consistent message delivery. Therefore, we chose to consolidate our efforts entirely on LinkedIn (Figure 3). This decision allowed us to focus all resources on the platform where we consistently found the highest quality engagement and where our niche industrial audience was most professionally active. In this way, we successfully generated 148265 impressions, mostly via LinkedIn. We did not manage to gather the community of 1000 stakeholders as per GA, but our strategy was successful in attracting the right people: 740 engineers, professionals, researchers, and potential end-users directly interested in ZDM, NDI, and Industry 4.0. This focus ensured quality engagement over raw, untargeted numbers.

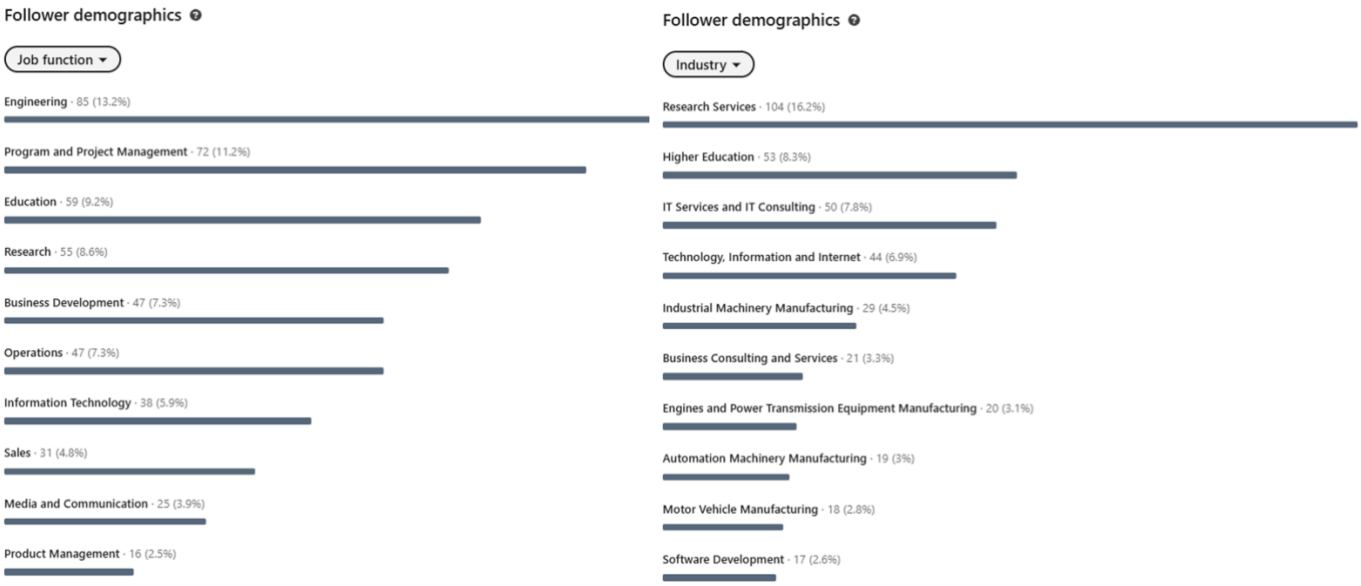


Figure 3: LinkedIn Follower demographics report (Last 365 days)

Overall, LinkedIn has proven to be an effective channel for connecting with professionals in the manufacturing industry, showcasing promising results about engagement and visibility. For example, as visible in Figure 4, achieving an engagement rate of 13.6% means that openZDM content was significantly resonating with our specific audience.

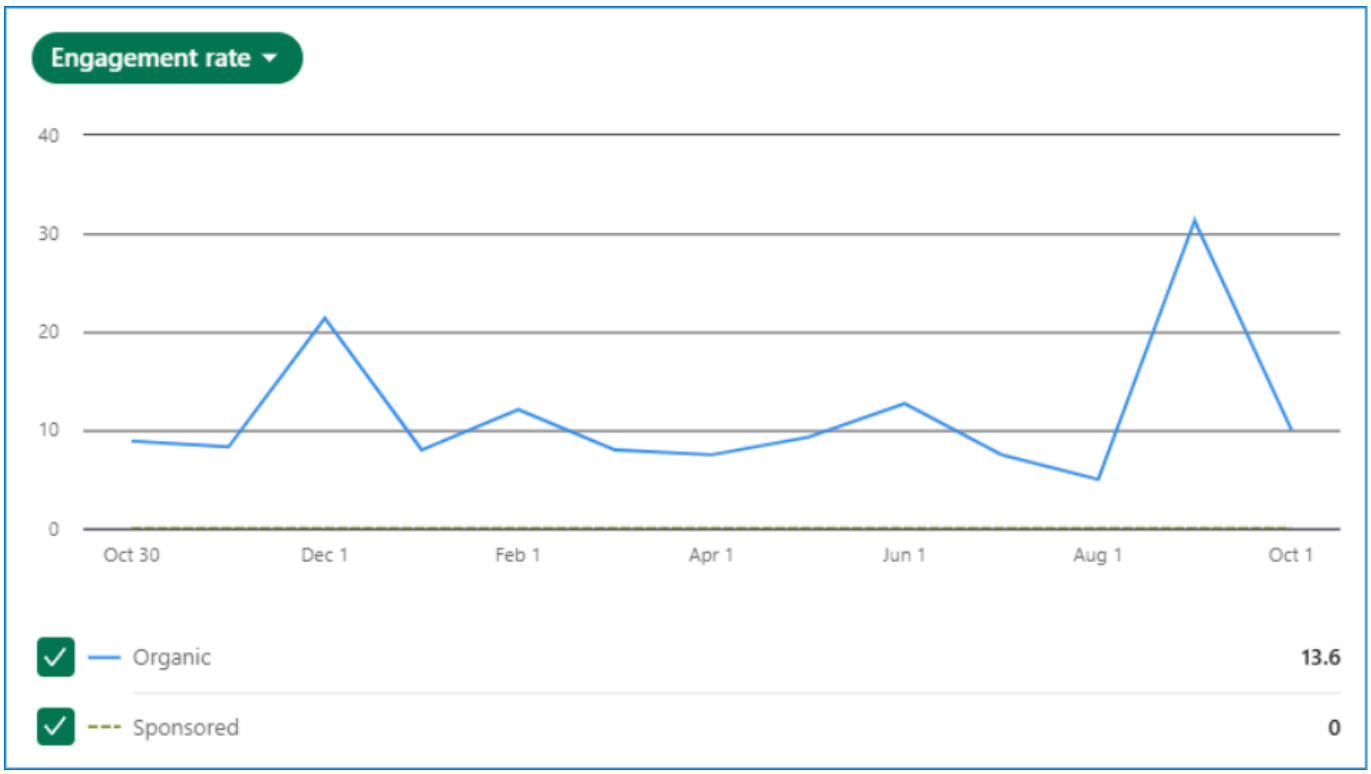


Figure 4: LinkedIn Engagement rate report (Last 365 days)

As part of our communication and social media strategy, openZDM has developed and implemented various campaigns aimed at increasing awareness, driving traffic, and engaging stakeholders. During the first year of the project, our focus was on bringing awareness around ZDM and sustainable manufacturing. In the intermediate phase of the project, we were focused on promoting openZDM pilots and sharing our technical knowledge with the community. During the last year of the project, we were sharing our scientific contributions to the research community, as well as the results gathered. We can conclude that the success on social media was achieved through a strategy of well-planned, consistent, high-quality posting coupled with targeted messaging, ensuring engagement came from the desired industrial and research personnel. While we didn't hit the stakeholder number, we maintained consistency and used targeted messages to make sure the right people, industry experts and researchers within the manufacturing industry, were interacting with the published content.

2.1.1.3 Newsletter

Throughout the project's duration, the openZDM newsletter served as a direct and reliable channel for delivering targeted updates and insights to interested parties who subscribed via the project website and social media platforms. Utilising Mailchimp as our GDPR compliant platform of choice, we successfully published a total of seven newsletters until M41 and are planning to publish one more, final newsletter in M42. All issued newsletters are publicly available at the openZDM website. Now, the openZDM newsletter community counts 262 subscribers with an average open rate of 42.3%, while we reached more than 1000 stakeholders over the course of the project by exploiting synergies with other similar initiatives. Therefore, the newsletter served as a vital tool for maintaining ongoing communication, fostering community engagement, and ensuring key technical developments reached our stakeholders.

The first newsletter was strategically issued in M6, coinciding with the public launch of the official openZDM website, and was designed with the goal of increasing project awareness and driving website visits and social media engagement. Subsequent newsletters (2, 3, 4, 5, 6) provided subscribers with a comprehensive overview of key project activities, highlighting articles, partner contributions, and the highly successful event attendance that proved to be one of our most effective communication activities. Newsletter number 7 was designed with the collaboration of all partners, as it was dedicated to the digital innovation hubs (DIHs), aiming to accelerate the necessary engagement and leverage their networks for future exploitation. With this strategy, we presented the openZDM platform and our main key exploitable results to more than **200 Digital Innovation Hubs (DIHs)**. The final newsletter is planned to be issued during the final month of the project, as the closing statement from the openZDM team.

2.1.1.4 YouTube channel

The openZDM project successfully leveraged its dedicated YouTube channel (Figure 5) as a crucial platform for dynamic visual dissemination, significantly exceeding initial targets by producing and publishing a total of 19 videos, among which the most watched was the official, animated openZDM video with 165 views. This multimedia library, which by far surpassed the minimum content requirements, included a diverse range of assets such as technical learning tutorials, event recaps, a dedicated openZDM platform demonstration video, partner interviews, and a valuable six-part video series developed in synergy with the GreenSMEs initiative. These visual resources were central to communicating the technical essence and practical developments of openZDM to all stakeholders. Regarding channel performance, the videos generated a total of 1093 views and accumulated 46.1 watch hours.

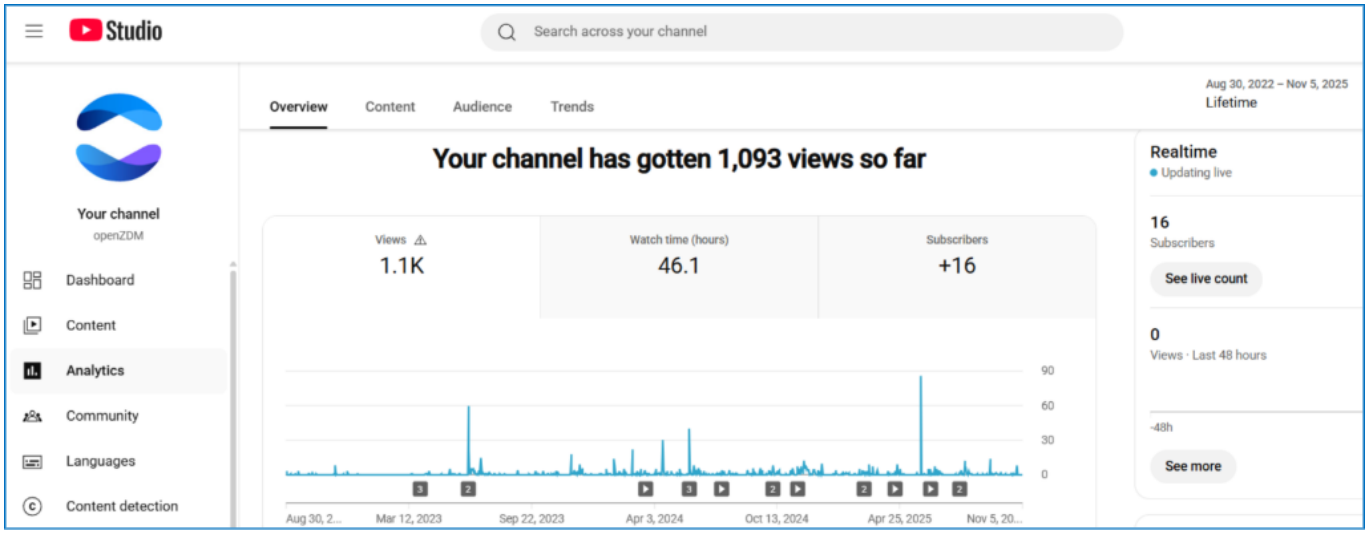


Figure 5: YouTube Studio Overview (Lifetime)

Despite operating within a highly specialised manufacturing niche, the channel achieved 9600 impressions with a strong 3.1% click-through rate (CTR) (Figure 6). These numbers confirm that when the content was presented to a user, the thumbnail and title were compelling enough to generate interest. This successful conversion rate confirms the high relevance of the video topics to the target audience.

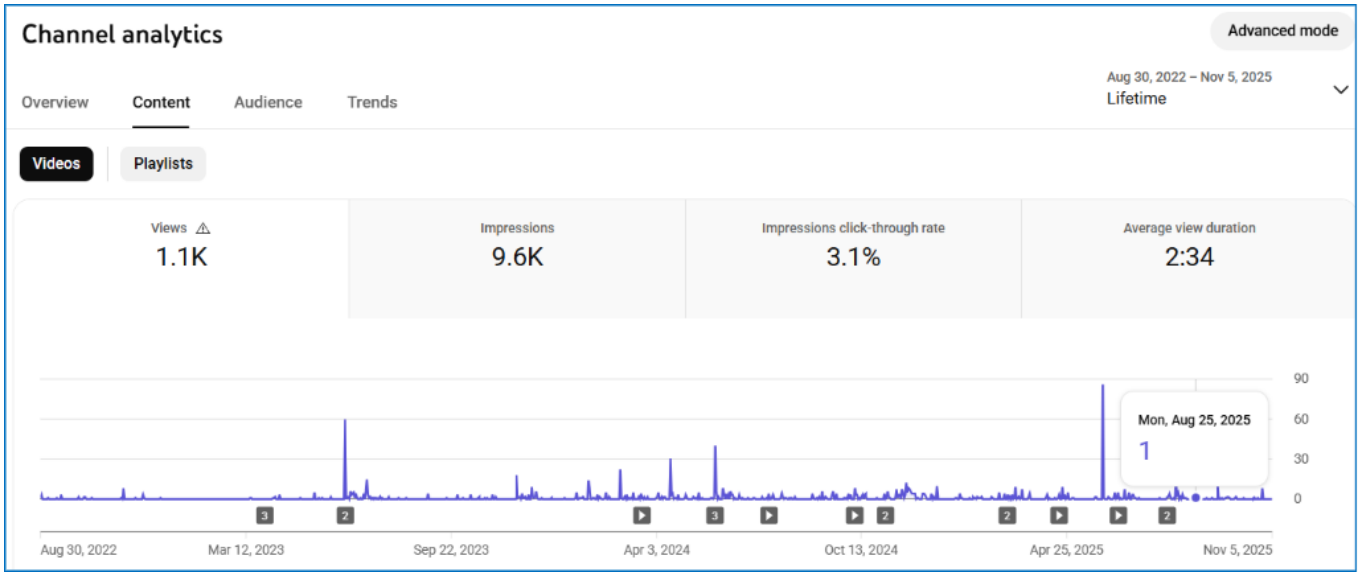


Figure 6: YouTube Studio Content Overview (Lifetime)

Crucially, most of the traffic sources were external, confirming that the visual content successfully circulated beyond the immediate partner and project network. Although the channel concluded with 16 subscribers, the performance metrics confirm that the extensive visual content proved highly effective in supporting external outreach and provided stakeholders with a valuable, dynamic representation of the project's outcomes and commitment to transparency.

2.1.1.5 Marketing materials

As detailed in Deliverable D6.2, the project developed a full suite of marketing materials, including posters, brochures, and flyers. These assets were designed for high-impact communication at external events, alongside promotional items such as tote bags, keychains, and pins used to boost openZDM visibility. Crucially, in adherence to our commitment to sustainability, the consortium made a conscious decision not to print over 2000 copies of materials to avoid unnecessary paper usage and to minimise potential waste. Instead, we focused on quality over quantity, strategically selecting high-impact dissemination events, such as scientific conferences and fairs, and delivering printed materials only where they would reach the most relevant stakeholders. This approach ensured that our dissemination efforts were both targeted and resource-efficient, saving paper without compromising the visibility of the key project information.

2.1.1.6 Public events

The openZDM consortium placed significant emphasis on direct stakeholder engagement through physical attendance at key industry and research forums. Since the previous reporting period (D6.2), the consortium attended an additional five public events, bringing the total number of participatory events throughout the project to 15, which successfully exceeded the project's original KPI target. These events are presented in Table 2.

Table 2: Overview of the openZDM's public events participation

Number	Event name	Year	Partner(s) involved	Activity
1	Industrial Technologies	2022	LMS	Poster promotion and leaflet distribution
2	I4MS	2022	LMS, F6S	Poster promotion and leaflet distribution
3	European Manufacturing Conference	2022	LMS	Poster promotion and leaflet distribution
4	World Manufacturing Forum	2022	UPORTO	Leaflet distribution
5	ZDMP Cluster Workshop	2022	LMS	Networking
6	Manufacturing Partnership Days	2023	LMS	Networking
7	FORD Collaboration Event	2023	TEC	Project presentation
8	Manufacturing Partnership Days	2024	LMS, F6S	Booth with project dissemination materials
9	European Manufacturing Conference	2024	LMS	Networking
10	Artificial Intelligence in Industry	2024	HT	Project presentation
11	AI, Data, Robotics Forum	2024	LMS	Networking (Figure 7)
12	ADMA Trans4mers final event	2024	INTRA	Project presentation
13	Webit/Future Forum	2024	F6S	Booth with project dissemination materials
14	Manufacturing Partnership Days	2025	LMS	Networking
15	Digital Manufacturing Industrial Workshops	2025	LMS, APTIV	Project presentations and workshops

Our participation in these events was disseminated via the official openZDM digital channels, such as the social media, newsletter and website. These events collectively proved to be one of the most effective communication activities, clearly highlighting openZDM's strong commitment to fostering collaboration and sharing knowledge directly with the European manufacturing community.

In addition to our presence at major public and industrial events, the project placed significant importance on inspiring the next generation of engineers and manufacturers. Our academic partners successfully organised 6 dedicated open days (Figure 8) at local educational institutions. These events engaged approximately 600 students in total, providing them with a direct opportunity to learn about the openZDM project. By focusing on the principles of sustainable manufacturing and the future of industrial quality control, these open days effectively positioned openZDM as a key contributor to driving a sustainable future in the sector, fostering both awareness and enthusiasm among potential future stakeholders.

Figure 7: openZDM participation in public events (ADRF24)

Figure 8: Open Day at UNIVPM

2.1.1.7 Press releases

We successfully published three formal press releases over the project's duration: the first immediately following the project kick-off in July 2022, the second in March 2024 to highlight the successful proof of concept for the openZDM platform, and a third release covering openZDM participation in the AUTOMATICA fair in March 2025. All press articles are publicly available on the openZDM website. The final press release is planned for Month 42, as a concluding announcement about the most important final highlights and achievements of the entire project. In addition, our efforts resulted in the accumulation of 22 press clippings (owned and external), such as the one in the INSIGHT magazine, confirming initial success in attracting media coverage and reinforcing openZDM's visibility within the manufacturing and research media landscape (Table 3).

Table 3: Overview of the openZDM's external media outreach

Number	Media name	Link
1	MSI website	https://www.msigrupo.com/openzdm-project-kom/
2	USIT website	https://u-sense.it/en/u-sense-it-partners-in-the-openzdm-project/
3	FEUP website	https://sigarra.up.pt/feup/en/projectos_geral.ficha_projecto?p_id=78614
4	ForeSee Cluster website	https://www.foresee-cluster.eu/
5	USIT website	https://u-sense.it/en/2022-openzdms-general-assembly/
6	DIISM UNVIPM website	https://diism.univpm.it/openzdm/
7	STEP IPB website	https://step.ipb.pt/projects/openzdm/
8	beopen website	https://beopen.openaire.eu/search/organization?organizationId=corda_____he::f1c995a87e3754ccd0bf118379a65957

Number	Media name	Link
9	AIMEN website	https://www.aimen.es/proyectos/openzdm
10	COMAU website	https://www.comau.com/en/about-us/funded-projects/digital-innovation-projects/
11	90 segundos de ciência	https://www.90segundosdeciencia.pt/episodes/ep-1648-paulo-leitao/
12	EFFRA website	https://portal.effra.eu/project/15644
13	Industry 5.0 magazine	https://industry.itismagazine.it/ingegneri-a-sps/tecnologie-digitali-per-la-produzione-a-zero-difetti-progetto-europeo-open-zdm/
14	Insight magazine	https://insightm.co.uk/article/openzdm-the-open-platform-for-zero-defect-manufacturing
15	USIT website	https://u-sense.it/en/2025-openzdms-general-assembly/
16	4ZDM Cluster website	https://zdmanufuture.org/projects/
17	AUTOMATICA website	https://exhibitors.automatica-munich.com/de/presseinformationen/presseinformationen-details/pressreleasesDetail/27297/?cHash=8a015e99805a5e91920523d2914f452c
18	I4q Project website	https://www.i4q-project.eu/projects-3
19	TURBO Project website	https://turboproject.eu/related-projects
20	F6S Innovation website	https://innovation.f6s.com/projects/?_thematic-area=manufacturing
21	OPTIMAI Project website	https://optimai.eu/1889-2/
22	GreenSME Project website	https://greensmehub.eu/category/project-results/

2.1.1.8 DIHs and Liaison with other initiatives

As mentioned previously in the newsletter section, we developed a specific newsletter strategy dedicated to contacting DIHs directly to gather their feedback and introduce the openZDM platform. In that way, via a special newsletter campaign named "Interested in zero-defect results?", we contacted a total of 215 digital innovation hubs (Figure 9).

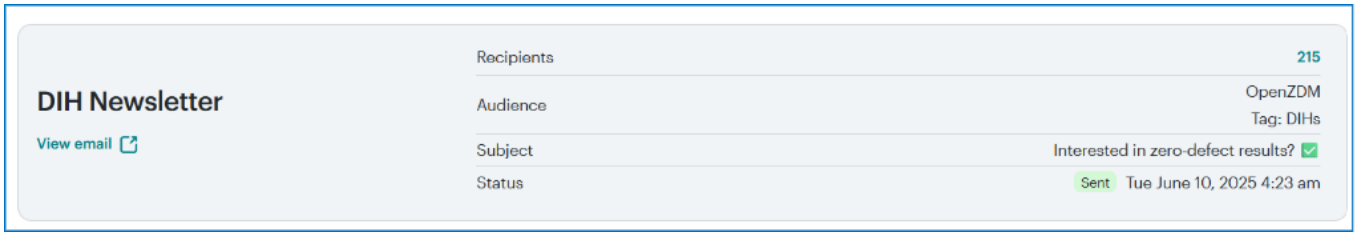


Figure 9: DIH Newsletter strategy (MailChimp)

The project actively engaged with a diverse and crucial range of related initiatives, including: ZDMP, EFFRA, 4ZDM cluster, ENGINE, FLASH-COMP, Platform-ZERO, TURBO, ZDZW, IDTA, CEN/CENELEC, GreenSME, RiseSME, DiMAT, Sitolub, and ADMA Trans4rmers. These engagements involved participation in dedicated one-on-one meetings, shared cluster events, joint dissemination activities, such as social media sharing, creation of the joint video-interviews, newsletter cross-promotion and similar. Through this active collaboration, we successfully shared insights, leveraged synergies, and coordinated efforts to advance common goals within the European manufacturing and digitisation domain. This ensured the openZDM results contribute effectively to the wider ecosystem.

2.1.1.9 Fora & Blogs

Since the last reporting period (D6.2), the consortium has significantly increased its output, creating an additional 22 owned blog posts, bringing the total number of articles available on the openZDM Insights page to 47. This achievement vastly surpassed the initial KPI of 6 posts and established the website as a rich resource for stakeholders. Furthermore, despite the earlier reported challenges, we successfully expanded our external outreach efforts in the final phase of the project. We managed to be featured in several external forums (INSIGHTM, AUTOMATICA), magazines (Veerkracht) and blog sections via organising a series of joint interviews with the GreenSME initiative. This ensured our key findings reached relevant external communities beyond our owned channels, which maximised the reach and visibility of the openZDM results.

2.2 Dissemination activities

Table 4 identifies all efforts made to reach the dissemination key performance indicators, confirming the high level of the dissemination activities implemented until the conclusion of the openZDM project.

Table 4: Dissemination KPIs overview

Measure	Target KPIs	Status [M24]	Status [M42]
Technical publications	>5 technical articles >2 white papers	1 technical article No white papers	7 technical articles 2 white papers
Scientific publications	>15 publications in scientific journals One book release	10 scientific publications Book release to be started	29 scientific publications No book release
Scientific Conferences	>15 publications and/or presentations delivered in major conferences	5 publications or presentations delivered at major conferences	17 publications or presentations delivered at major conferences
Trade fairs/ exhibitions	>10 participations in major events/trade fairs >5 banners/ posters	2 major events/trade fairs 7 banners/posters	9 major events/trade fairs 8 banners/posters
Workshops through associations, communities and clusters	>2 technical workshops >2 workshops presenting use case results	16 internal technical workshops Workshops presenting use case results to be started	20 internal technical workshops 7 workshops presenting use case results
Training	>2 online training tutorials >3 presentations to schools/ universities	2 online training tutorials 2 presentations to schools/universities	4 online training tutorials 11 presentations to schools/universities
Standards	>4 SDOs involved >4 standardisation contributions	2 SDOs involved 1 standardisation contribution	2 SD0s involved 2 standardisation contributions

The data above was populated on 31st October 2025 – one month before the official end of the project (M41).

The project's overall dissemination strategy was highly successful, culminating in the achievement and often significant overachievement of the majority of our dissemination KPIs. Our efforts ensured the openZDM results were effectively integrated into both the academic and industrial communities. We successfully surpassed targets for the publication of technical articles (117%), the creation of learning tutorials (133%), the delivery of scientific publications with most adopting an open-access model to maximise reach (181%), the participation to the scientific conferences (106%), number of presentations delivered to schools (275%), and the overall number of internal (667%) and external (233%) workshops conducted. While these successes firmly established openZDM's technical legacy, we acknowledge that a few specific targets proved challenging to meet. We delivered 2 white papers, we went to 9 fairs, and the planned publication of a book was not realised. Furthermore, the complex and time-intensive nature of standardisation work meant that not all standardisation KPIs were fully fulfilled. Despite these shortfalls, we believe that the openZDM consortium has ensured the widespread availability and successful uptake of the openZDM platform and its innovative technology.

2.2.1 Dissemination tools and channels

2.2.1.1 Technical publications

The consortium successfully published a total of 7 technical articles, all available at the openZDM website, page Results, section Technical articles. These publications were crucial for sharing specialist insights, innovations, and advancements within the field of Zero-Defect Manufacturing (ZDM) and are covering topics such as the platform's architecture, the integration of Non-Destructive Inspection (NDI) systems, uncertainty management, the digital twin concept and similar. This output ensured that the technical community had direct access to the core engineering knowledge generated by the openZDM project.

2.2.1.2 Scientific publications

The openZDM project has made a substantial contribution to the academic and research community, concluding with a total of 29 officially published scientific papers. This output significantly exceeded the initial targets and demonstrates the research that underpinned the project's technical outcomes. Crucially, most of these publications were made open access, ensuring that the project's findings and advancements are freely available to researchers, practitioners, and industry experts across Europe and worldwide. All published articles are conveniently accessible via the project's website, page Results, section Scientific publications.

2.2.1.3 Scientific conferences

The openZDM project placed significant importance on engaging the academic community, ensuring our research and innovation were validated and discussed by peers. Throughout the project's lifecycle, the consortium actively participated in a total of 17 scientific conferences presented in Table 5.

Table 5: Overview of the openZDM's scientific conference participation

Number	Event name	Year	Partner(s) involved	Activity
1	IEEE International Workshop on Metrology for Industry 4.0 & IoT	2023	UNVIPM	Paper presentation
2	DMIS	2023	LMS, AIMEN, USIT, F6S	Project dissemination and leaflet distribution
3	Forum delle Missure	2023	UNVIPM	Abstract presentation
4	International Conference on Industry 4.0 and Smart Manufacturing	2023	LMS	Dissemination
5	CIRP LCE	2024	UNVIPM	Paper presentation
6	Conference on Learning Factories	2024	UNVIPM	Paper presentation
7	Conference on Computer Aided Tolerancing	2024	UNVIPM	Paper presentation
8	MetroInd4.0&IoT Conference	2024	UNVIPM	Paper presentation
9	ISM	2024	APTIV	Paper presentation
10	CIRP ICME	2024	LMS	Dissemination
11	Forum delle Missure	2024	UNVIPM	Dissemination
12	2nd European Symposium on Artificial Intelligence in Manufacturing	2024	LMS	Dissemination
13	International Conference on Informatics in Control, Automation and Robotics	2024	UPORTO	Project presentation
14	IEEE International Conference on Emerging Technologies and Factory Automation	2024	UPORTO	Dissemination

Number	Event name	Year	Partner(s) involved	Activity
15	DIISM Congress	2025	UNVIPM	Poster presentation
16	IEEE International Conference on Emerging Technologies and Factory Automation	2025	UPORTO, LMS, TEC USIT, IPB UNVIPM, AIMEN	Project presentation (Figure 10)
17	Sustainable Places	2025	LMS	Project presentation

These conferences allowed us to exchange insights and advancements in ZDM, successfully fostering collaboration and demonstrating openZDM's contribution to the scientific foundation of sustainable manufacturing. As for the public events, participation to these scientific gatherings was disseminated via social media, newsletter and website.

Figure 10: openZDM team at the ETFA Conference (2025)

2.2.1.4 Trade fairs and exhibitions

To translate our research into industrial uptake, the project team participated in a total of 9 major trade fairs and industrial events, as presented below in Table 6.

Table 6: Overview of the openZDM's trade fairs and exhibitions participation

Number	Event name	Year	Partner(s) involved	Role
1	TechChill Milano	2022	F6S	Booth with project dissemination materials
2	Control Messe	2024	USIT, UNVIPM	Booth with project dissemination material and a prototype of NDI#8 (the G3F)
3	1st Automation & Robotics EXPO	2024	LMS	Dissemination

4	SPS Fiera	2024	USIT	Project presentation
5	BeDigital	2024	MSI	Booth with project dissemination materials
6	Global Innovation Day	2024	TEC	Booth with project dissemination materials
7	AUTOMATICA	2025	LMS, INTRA, USIT, F6S, UNVIPM	Booth with project dissemination materials (Figure 11)
8	Control Messe	2025	UNVIPM	Booth with project dissemination materials
9	IndTech	2025	LMS	Dissemination

Our presence at these trade fairs was essential for demonstrating the ZDM approach in a commercial context, gathering valuable industrial feedback, and establishing the key relationships necessary for the final exploitation of the project results.

Figure 11: openZDM team at the AUTOMATICA Fair (2025)

2.2.1.5 Training tutorials

To facilitate the rapid adoption of the openZDM platform and its core concepts, the project delivered 4 dedicated training tutorials by Month 41, all of which are readily available on the openZDM website, page Results, section Learning tutorials. These tutorials were specifically designed to complement the technical articles and dive deeper into data analytics and data augmentation, as well as the role of measurement in ZDM, providing practical, step-by-step guidance. Additionally, a hackathon for students has been hosted, serving as another valuable training opportunity.

2.2.1.6 Open data access (Zenodo)

The openZDM community on Zenodo has a role to ensure the long-term accessibility and preservation of the project's intellectual outputs. This platform serves as the comprehensive, centralised repository for all scholarly contributions. Here, on our verified account, which is part of the EU Open Research Repository by European Commission, we curated a diverse and growing collection of materials, including final technical and scientific publications, raw and processed datasets, conference presentations, and workshop materials, effectively providing a single, reliable point for research dissemination and open collaboration.

2.2.1.7 Key outcomes and lessons learned

The openZDM project successfully concluded its Communication and Dissemination efforts, providing crucial insights into effective outreach within the highly specialised Zero-Defect Manufacturing (ZDM) industry. Operating in this technical niche required a communication strategy that prioritised quality over quantity and aimed for long-lasting impact. Despite the demanding nature of the initial Key Performance Indicators (KPIs), we successfully cultivated highly loyal and engaged community of researchers and industry professionals, evidenced by superior metrics like our high LinkedIn engagement rate, technical content downloads and very engaged website audience. This focused approach ensured that every communication touchpoint resulted in meaningful interaction with the stakeholders most capable of exploiting the openZDM results post-project. The boost in website performance and content creation during the final phase of the openZDM project was a direct result of the full consortium effort, showcasing that commitment from all partners is essential to overcome unexpected external hurdles. This

collective dedication ensured resources were reallocated effectively to the most impactful channels. Therefore, exploitation of already existing consortium networks is essential for overall project success. Another key lesson learned was the absolute necessity of maintaining an agile communication and dissemination strategy, allowing for critical flexibility in response to the changing digital landscape. The sudden instabilities on platforms like Twitter/X and the fundamental shift in web analytics (GA4) demanded swift mitigation actions, such as consolidating efforts on LinkedIn and initiating SEO work. It is important to note that, at the moment of writing this final report, the project still has one month remaining in its official lifecycle, while the communication team expect to prolong its activity even after the project ends, during December 2025, with the purpose of effective project closure. In conclusion, the openZDM project met its core C&D obligations by achieving, and in many critical areas, significantly overachieving the majority of its initial KPIs, **s**uch as over-delivering on video production and targeting high-impact events. Furthermore, the project went beyond the simple fulfilment of numerical targets by intentionally focusing on sustainability (like reducing printed materials) and maximising the exploitability of the consortium's technical output. We are confident that the sustained communication momentum will continue to drive further visibility and engagement, ensuring the openZDM legacy extends well beyond the project's official conclusion.

3. Final Update on the openZDM Exploitation activities and Go-to-Market Strategy

3.1 Progress towards the openZDM exploitation and IPR Management plan

During the second half of openZDM, the project activities were focused on consolidating the IPR management agreement of the project, finalising the list of Exploitable Results (ERs), and developing a go-to-market strategy for the openZDM integrated platform and the key technologies in the project, also via the support of the Horizon Booster Services.

The activities implemented and their respective outcomes achieved are as follows:

The final list of **18 exploitable results** has been validated, respecting the technical evolvements in the project, including 3 core categories, namely the **(i)** openZDM integrated platform – beta version, **(ii)** software services (e.g., digital twin toolset, decision making toolset, data analytics) of the openZDM platform, and **(iii)** platform NDIs (e.g., laser line triangulation system, thermal imaging, etc.). Each result was documented with ownership/leadership status and the planned exploitation pathway (individual or joint).

An **IPR agreement** was drafted and validated by partners, defining ownership, access rights, background IP usage, and exploitation rights after project completion. INTRA coordinated partner feedback and integrated all contributions into the final IPR agreement included in this deliverable (In Section 3.8). The agreement clarifies leadership and post-project responsibilities for all exploitable results to make their re-use among partners as transparent as possible.

An updated **market analysis** was carried out covering the EU manufacturing ecosystem and identifying high-potential sectors for zero-defect manufacturing with quantitative estimates of market size and the competitive landscape. Focus was given on automotive, battery factories, steel, and glass production. A SWOT and trend analysis positioned the openZDM integrated platform as an enabler of data-driven manufacturing aligned with EU Industry 5.0.

The consortium leveraged the **Horizon Results Booster Service**, specifically Module B “Unique Value Proposition (UVP) and Key Exploitable Results (KER)” and Module C “Exploitation Strategy”, which provided guidance on market segmentation, exploitation roadmap design, and value proposition refinement. The outcomes directly fed into this deliverable regarding the final business models and go-to-market strategy.

Via 3 dedicated workshops among the involved partners, a strategy was defined for the three main exploitable results:

- **openZDM Integrated Platform**: could be commercialised as a cloud or on-premises solution via licensing and integration agreements with OEMs and Tier 1 suppliers. The platform governance will be guided by the IPR agreement (to be offered via service bundles), while the exploitation leader and contact point of the platform will be INTRA (as the platform integrator).
- **G3F Portable Sensor**: commercialised directly by USIT, targeting quality control in automotive and household appliances.
- **Laser Line Triangulation System**: exploited via consulting/technology transfer by UNIVPM to industrial partners like VDL Weweler and potential licensing to sensor manufacturers.

To support the visibility and outreach of the ERs, **marketing material** was created in collaboration with the dissemination and communication activities (in Task 6.1), targeting Digital Innovation Hubs in the EU.

Each **industrial use case** (automotive, steel, glass, wood panels, electric components) **was analysed for its business value and impact** via an online survey that was developed by INTRA. The results are presented in Section 3.5. Finally, all consortium partners of the project have designed the **individual exploitation plans of their organisations**, indicating how they will re-use the 18 ERs in commercial and research activities after the end of openZDM. This information is presented in Section 3.3.

3.2 Final list of the openZDM Exploitable Results

Following several consultations and iterations among partners in this last reporting period via an online .doc template, the **final list of openZDM Exploitable Results (ER),** along with a non-technical description of each result and the partners who act as owners/leaders, is presented in this Section. Exploitable results were basically defined as the tangible technological or knowledge-based outputs generated by the project (mostly the technological tasks) that have clear potential for industrial, commercial, or research use beyond the project's duration. They were selected based on criteria such as technological readiness and alignment with the project's industrial use cases (solutions that have been tested/ integrated into the beta version of the platform).

Compared to D6.2, where 23 ER are reported, in D6.3 the list of ER has been updated and divided into 18 ER. In D6.3, the exploitable results were updated by aligning them with the final technical outcomes and then validated via an online partner template (confirming descriptions, roles and intentions), so that the consolidated list of 18 ERs can act as the openZDM Results Ownership List and a solid foundation for IP protection, future exploitation and commercialisation. The final list of the openZDM ER is presented in Table 7.

Table 7: openZDM Final List of Exploitable Results

ER #	Name	Leader(s)	Description
1	Laser line triangulation system (low/high temperature)	UNIVPM	A laser-based measurement system enabling accurate geometric inspection of industrial steel bars in both low and high temperature environments.
2	Thermal camera before descaling	UNIVPM	A thermographic inspection unit monitoring temperature distribution of steel bars before descaling to support process optimisation.
3	Thermal camera after descaling	UNIVPM	A thermographic system capturing post-descaling surface conditions to assess temperature uniformity and oxide removal.
4	3D dimension measurement system	UNIVPM	An automated 3D inspection solution using laser triangulation to measure dimensions of industrial components.
5	Vision for surface defect detection	AIMEN	A machine-vision inspection system designed to detect surface defects on manufactured components using image analysis.
6	IIoT portable laser line triangulation for gap & flush (G3F)	USIT	A portable industrial sensor enabling real-time measurement of gap and flush between assembled parts across multiple use cases.
7	Thermal camera for glass bottle thickness measurement	TECNALIA	A thermal-imaging system estimating glass bottle thickness during hot-end production for quality monitoring.
8	IR thermal camera for early detection of welding defects	COMAU	An infrared monitoring solution supporting early identification of welding anomalies in automated production lines.
9	2D camera application for welding process monitoring	COMAU, LMS, APTIV	A 2D vision-based inspection tool for detecting positional and welding-related defects in battery assembly processes.

ER #	Name	Leader(s)	Description
10	Data-driven analytics modules for quality assessment	IPB, UPORTO, HABBER, LMS, TECNALIA	A suite of predictive, monitoring, and reconfiguration analytics modules supporting quality assessment in manufacturing.
11	Framework for training, deploying and updating analytics modules (DAT Training App)	LMS	A software framework enabling streamlined training, deployment, and updating of data-driven quality assessment models.
12	Methodology & app for point-cloud dimensional defects	LMS	A software tool that processes point-cloud data to detect dimensional anomalies in steel products.
13	Decision Support Tool (DST)	LMS	A decision-making tool evaluating alternative process configurations based on user-defined KPIs for optimisation.
14	Digital Twin Toolset (DTT)	LMS	A hybrid digital-twin environment combining data-driven and physics-based models for process simulation and monitoring.
15	DTT Configurator	MSI	A configuration and deployment tool enabling modular setup and monitoring of microservices within digital-twin environments.
16	Pilot Implementations' Digital Twins	LMS, MSI, UPORTO, IPB	Digital twin models deployed across the five pilots, enabling real-time process visibility and predictive insights.
17	Core openZDM middleware layer	INTRA, LMS	The core interoperability layer of openZDM, enabling secure data exchange and communication between manufacturing assets and digital tools.
18	openZDM integrated platform	INTRA, LMS, MSI, IPB, HT_PT, TECNALIA, UPORTO	A modular digital manufacturing platform supporting real-time monitoring, analytics, and decision-making for Zero-Defect Manufacturing.

3.3 Final Individual Exploitation Plans per openZDM Partner

The individual exploitation plans per partner were gathered and analysed in the last reporting period. All organisations in opeZDM have compiled a detailed plan on how they envision reusing the project results (as they presented in Section 3.2), either for commercial, research activities or by continuing their implementation in the production lines as end-users. Different organisation types (i.e, technology providers, universities, intermediaries, manufacturing companies) envision various use models and exploitation models (e.g., direct sales, licensing, consulting services, technology transfer, further research, further piloting of the results), depending on their different business needs. An online .doc template was used to gather feedback from all partners. A summary of partners' exploitation plans per organisation type is presented below.

Organisation Type 1: Academic/ research and intermediaries (LMS, UNIVPM, IPB, UPORTO, TECNALIA, AIMEN, F6S)

Academic and research partners primarily intend to use the project results to strengthen their research and teaching activities. The developed methodologies, software modules, and insights generated during openZDM will support future R&D proposals, training programs, and collaborations with industry partners. Several partners foresee continued work on digitalisation, data analytics, and non-destructive inspection concepts in follow-up projects at the national or European level. In addition, research partners will integrate selected outcomes into demonstrators, teaching curricula, and postgraduate education, thus supporting long-term knowledge transfer. Intermediary organisations will incorporate communication, dissemination, and ecosystem-building practices derived from openZDM into future innovation support activities.

Organisation Type 2: Industrial End-Users (VDLWEW, VWAE, SONAE, VIDRALA, APTIV)

Industrial end-users plan to continue exploring the applicability of the project's solutions within their production environments. Depending on internal priorities and validation results, various openZDM components may be further tested, adapted, or integrated to support quality monitoring, improved process visibility, or data-driven decision-making. The insights gained from piloting activities will guide each end-user's internal

digitalisation strategy and may inform future in-house developments or collaborations. End-users also plan to retain knowledge gained during the project, particularly regarding predictive analytics, digital twins, and advanced inspection approaches, in order to enhance operational efficiency in their respective manufacturing domains.

Organisation Type 3: Large Companies and SMEs (INTRA, COMAU, USIT, HT_PT, MSI, INDUCTION)

Technology-providing partners aim to leverage the knowledge and tools developed in openZDM to enhance their existing products, services, and technological capabilities. This will include making the software components more mature, integration of selected functionalities into existing product portfolios, development of new service offerings, or continuation of research activities related to digitalisation and automation. Some partners foresee using openZDM results to improve internal processes, strengthen their position in relevant industrial domains, or support future collaborations with manufacturing stakeholders. SMEs involved in digital technologies will extend their expertise toward consultancy, integration, or solution development inspired by insights gained during project implementation.

3.4 openZDM and Horizon Results Booster Services

The consortium engaged with Horizon Results Booster support programme covering **Module B (Unique Value Proposition & KER)** and **Module C (Exploitation Strategy)** for both ER#6 (G3F – IIoT portable laser line triangulation device) and the openZDM Integrated Platform (ER#18). An expert was dedicated to supporting the project's exploitation activities, who guided the consortium partners via exercises, where in total, 4 online HRB sessions were conducted during October and November 2025. These sessions were facilitated by the external expert assigned to the project and followed the standard HRB methodology, enabling a refinement of our market approach and exploitation logic. Each workshop served as a business development exercise where the involved project partners validated customer profiles, segmented early adopters, clarified value drivers, and aligned the positioning of both results with real market needs across the EU manufacturing landscape.

During these sessions, partners (with INTRA acting as the facilitator) developed and validated a complete Market Definition Canvas (MDC), mapping the jobs-to-be-done, job executors, market boundaries, and competing solutions for both results. In parallel, a Value Proposition Canvas (VPC) was built for each KER, based on concrete user pains (e.g., lack of real-time quality control, absence of data availability in manual tools, interoperability gaps, high cost of defects) and quantifiable customer gains (e.g., accuracy, waste reduction, productivity improvements).

Then, based on this information, we elaborated on the Lean Business Model Canvases to define the cost structure, revenue models, channels, unfair advantages, and commercial pathways, leveraging the industrial evidence gathered in the pilots (e.g., multi-material measurement capability for G3F, API-driven architecture and AAS-based interoperability for the openZDM platform). This exercise helped the consortium to translate technical capabilities into clear business narratives and commercially viable models that will support sustainability.

Building on these insights, the Module C sessions focused on the full exploitation strategy and exploitation action plans for ER6 and the integrated platform. This included defining exploitation owners, commercialisation pathways, licensing options, early-adopter engagement strategies, and detailed risk assessment across business, market, and technological dimensions. The above resulted in an HRB report, where the expert highlighted key actions to be taken and areas for improvement. Hence, Table 8 summarises the action points suggested by the HRB service and how we address these points in this deliverable.

Table 8: Booster Service Recommendations

HRB Recommendation (Common for all ERs)	How It Was Addressed in the D6.3
Refine customer profiles and early adopters	Updated customer segmentation per sector; integrated pilot feedback; mapped job executors via the Market Definition Canvas exercise.
Strengthen the competition analysis	Added comparison of competing platforms and inspection systems in the Market Analysis Section; identified differentiation (AAS, real-time analytics, portability, ergonomics).
Clarify market drivers and needs	Documented industry drivers (ZDM adoption, sustainability, cost reduction); linked also the pilot value creation.
Improve business & use models	Completed Lean Canvas for both KERs; included business model options (licensing, service contracts, integration fees).
Define the exploitation strategy & roles	Added individual and joint exploitation plans; described partner roles, ownership, and intended post-project activities.

HRB Recommendation (Common for all ERs)	How It Was Addressed in the D6.3
Clarify IPR, ownership, and background knowledge	Implemented an IPR Agreement with ownership mapping, background IP, and conditions for use after project completion.
Develop exploitation roadmap	Integrated a roadmap into the exploitation model of the openZDM platform.

3.5 Sustainability Analysis and Business Feasibility for the openZDM Use Cases

Before delving into the openZDM integrated platform business plan (in Section 3.6) and the exploitation strategies for the ER (in Section 3.7), which are the plans that will guide the future sustainability of project results, an analysis of the testbeds where these solutions were applied is important to be conducted. Hence, to assess the concrete value generated by openZDM solutions in real industrial environments, a structured survey was conducted across all five project use cases. The questionnaire captured quantifiable inputs directly from the end-user organisations (namely, VWAE, VDLWEW, VIDRALA, SONAE, and APTIV), focusing on operational performance indicators, defect-related costs, process efficiency, sustainability improvements, and the perceived maturity and future adoption intentions of the deployed solutions. The key points this analysis tried to capture were the perceived impact of openZDM solutions in the pertinent use cases and whether the use case owners (who are also initial market adopters of the solutions) would be willing to keep using the ER after the end of the project. In principle, this survey constitutes the core evidence base supporting the project's exploitation and value-creation analysis and informs the prioritisation of exploitable results in the subsequent business planning activities. From an operational point of view, the survey was designed and deployed by INTRA (as the exploitation task leader), it was answered by all use case owners in openZDM (5 responses), and it was launched during October 2025 (where the use case has final results). The questions addressed are in Table 9.

Table 9: Sustainability Analysis and Business Feasibility - Survey Questions

Thematic Area	Questions addressed
Relevance and utility of the ER	• Which Exploitable Results (ERs) did you find most useful in the specific use case? (tick all that apply)
Problem definition / pain point	• Which concrete pain point in the production process does the use case address (e.g., quality defects, cycle time, energy efficiency, operator safety)?
Impact areas assessed	• Productivity (output per time unit) • Process efficiency (reduced idle time, improved workflow) • Quality performance (defects reduction, first-pass yield) • Energy consumption or waste reduction • Data interoperability and sharing between systems • Process flexibility or reconfigurability
Pilot performance and potential observed improvements	• Please describe specific changes or measurable improvements observed during pilot operation. • What is the concrete value for the manufacturer?
Financial assessment	• Estimated CAPEX investment for OpenZDM solution (€). • Expected annual cost savings or added revenues (€). • Expected payback period (months). • In your view, what is the main economic driver of value creation (e.g., scrap reduction, reduced maintenance, higher throughput, energy savings)?
Scalability and replication potential	• If the solution were to be replicated in other lines/plants, what would be the estimated scalability potential (number of lines/cells, % of factory coverage)?
Assessment of key technical components	• AAS-enabled platform (connectivity/interoperability). • Decision-making toolset & Digital twin toolset (real-time synchronization, data exchange). • NDI/inspection systems (hardware integration). • Data-driven analytics (DAT) for quality assessment (AI-based defect prediction and visualization tools).

Thematic Area	Questions addressed
Readiness and any required improvements	• Which additional functionalities or improvements would be required to make the solution fully production-ready? • What were the main technical or organizational barriers encountered during integration or operation?
Regulatory and any potential standards constraints	• Which regulatory, certification, or safety requirements must be addressed before large-scale commercial adoption? • Are there sector-specific constraints that might limit adoption? • How feasible would it be to achieve compliance with existing standards?
Future exploitation intentions	• What is your organization's willingness to continue using or expanding the openZDM results after project completion? (Scale: 1 = not at all, 5 = very likely) • What are the main conditions that would enable future adoption (e.g., commercial support, training, maintenance services, licensing model, interoperability guarantees)? • Would your organization be interested in co-developing or co-investing in a commercial exploitation path for any of the openZDM platform components?
Any other final inputs	• Any other comments or suggestions to support the exploitation and sustainability of the openZDM results?

Lastly, while each industrial setting presents unique process constraints, the cross-cutting findings show that predictive analytics and digitalisation tools are perceived as particularly valuable for strengthening real-time visibility, reducing quality losses, and enabling more informed decision-making. The relevance of interoperable architecture also emerged as a key enabler for future scalability, especially where organisations aim to integrate heterogeneous shop-floor systems or consolidate data flows for process optimisation. From a feasibility perspective, most use cases recognised meaningful potential for replication and long-term sustainability once solutions reach appropriate levels of robustness, ease of use, and accuracy. The analysis highlighted some recurring needs of the industrial partners prior to the full-scale integration of similar solutions, such as improving user experience, ensuring reliable integration into existing IT/OT environments, and strengthening cybersecurity and data-governance practices. Regulatory constraints were generally limited, with the main considerations relating to cybersecurity and sector-specific operational standards. Most of the openZDM industrial partners expressed interest in continuing to explore and potentially adopt the developed solutions, depending on their technical maturity and support services, which will ensure the uninterrupted service delivery in the production lines.

3.6 openZDM integrated platform Business Plan

3.6.1 Product/ Service description

The **openZDM Integrated Platform (ER #18)** is an end-to-end digital environment that connects assets, non-destructive inspection systems (NDIs), digital twins, machine learning analytics, and decision-making applications into one interoperable and modular ecosystem. The platform is built on the **RAMI 4.0 reference model** and implements **Asset Administration Shells (AAS)** as the unifying semantic layer, so that all machines, sensors, digital twins and applications exchange structured data in a vendor-agnostic way. At its core, the platform has a **middleware-enabled industrial operating layer**, supporting real-time monitoring, predictive quality control, process optimisation, and proactive decision making. Its architecture combines:

- **AAS Middleware Layer (ER#17)** providing device-independent deployment.
- **Digital Twin Toolset (ER#14) and Configurator (ER#15)** for hybrid simulation and 3D visualisation of assets.
- **Data-driven Quality Analytics (DATs – ER#10)** with statistical models, ML algorithms, defect prediction workflows and anomaly detection tailored to each openZDM pilot line.
- **Decision Support Tool (DST – ER#13)** for cost/quality/sustainability trade-off analysis and scenario evaluation (also recommendations for process adjustments).
- **User Interface Layer**, with role-based dashboards for operators, engineers and managers, with KPI visualisation, digital twin interfaces.
- **Integration and Data Management Services**, with connection to existing MES/PLC/ERP systems, legacy machines, new NDIs, and cloud/on-premise processing pipelines.

The platform is deployable **fully on-premise**, **cloud-based**, or in **hybrid mode**, depending on data sovereignty and cybersecurity requirements.

Rather than adopting a single 'of-the-shelf' commercial package, the openZDM integrated platform could be commercialised via use case-customised Service Bundles (SB), reflecting the actual combination of tools, NDIs, analytics and digital twins deployed in each industrial pilot. Each bundle represents a distinct commercial configuration with specific partner contributions in ownership and governance. These bundles (Table 10) replicate the validated deployments demonstrated in the five project use cases. Inspection data may originate from NDIs developed as part of the openZDM portfolio.

Table 10: openZDM Product Description - Service Bundles per Manufacturing Domain

Service Bundle	Included Components/ ER	Commercial Value Delivered
SB1 – Steel Processing ZDM Bundle (Steel trailing arms use cases)	Incorporates core platform services (middleware and AAS-based integration), Digital twin functionalities, decision-support capabilities, and selected data analytics toolsets for dimensional monitoring, surface assessment, and process insights.	• Real-time straightness, temperature and surface defect monitoring • Predictive defect detection across dimensional parameters • What-if optimisation via DST
SB2 – Automotive Assembly ZDM Bundle (Car Body shop and final assembly use case)	Integrates the openZDM middleware with digital twin support tools, data analytics modules, and shop-floor visualisation services.	• Portable in-line metrology for stations with no automation • Predictive gap/flush analytics • Data correlation and analysis from the shopfloor • Early warning for misalignments
SB3 – Wood Board Quality Prediction Bundle (Wood board use case)	Combines the platform's integration layer, digital-twin simulation capabilities, decision-support methodologies, and a subset of the ER10 analytics modules for predictive quality, setpoint exploration, and model-performance tracking.	• Better prediction accuracy across different defect types • Real-time recommendations for process parameter optimisation • Dashboard allowing preventive action prior to defect formation
SB4 – Glass Bottle Manufacturing ZDM Bundle (Glass bottling use case)	Includes platform services for integrating thermal-imaging data, digital twin support for process representation, analytics modules for thermal-pattern interpretation (from the ER10 suite), and configuration interfaces for managing model deployment.	• Predicts thickness issues before quality checks • Reduces defective bottles • Hot-end optimisation based on gob characteristics • Batch-level quality traceability
SB5 – EV Battery Module Quality Bundle (Battery module welding & assembly use case)	Combines the platform middleware, digital twin support for machine-process modelling, decision-support capabilities, and analytics modules tailored toward weld-quality assessment, anomaly detection, and machine-state correlation.	• In-line detection of welding defects • Operator feedback loop improves ML model over time • Supports early rejection prevention and parameter optimisation

3.6.2 Market analysis and trends for the openZDM integrated platform

The openZDM integrated platform addresses a broad and growing demand for advanced quality control and "zero defect" solutions in manufacturing, specifically targeting the discrete manufacturing sector. Europe's Industry 4.0 market reached €43.6 billion in 2023 and is forecasted to expand strongly by 2030 (CAGR almost 19%), driven by manufacturing automation, predictive quality, and interoperability frameworks such as RAMI 4.0 and AAS [1]. The global quality control and inspection market is also large. For instance, the global quality control market is expected to grow to €55.1 billion by 2030 [2]. Europe historically accounts for about 31% of this market, making it one of the highest-spending regions in industrial quality assurance. Likewise, the zero-defect manufacturing platform segment

is also expanding at a high pace. A report estimates that the global ZDM platforms' market stands at €1.93 billion in 2024 and is projected to grow to €7.73 billion by 2033, representing a CAGR of approximately 16.5% [3].

Based on our analysis (Figure 12), we segment the openZDM based on the pilot use cases, since from a technical perspective, the platform (and the partners/ technology providers) is better suited to serve these markets, capitalising on the knowledge from openZDM. The analysis targets the following segments:

- **Automotive Manufacturing:** The automotive sector is one of Europe's largest industries, accounting for about 8% of EU manufacturing value added. It produced **14.8 million motor vehicles in 2023** (including **12.2 million cars**)[4]. There are **255 vehicle assembly, engine, and battery plants across the EU**, and automotive manufacturing remains a cornerstone of EU exports (extra-EU vehicle exports worth €171.4 billion in 2022) [5].
- **Electric Battery Manufacturing:** Driven by the electric vehicle boom, Europe's battery manufacturing capacity is scaling rapidly. EU battery production is expected to reach **238 GWh in 2025** (up from just 69 GWh in 2022) and further **773 GWh by 2030** [6]. Numerous **"gigafactory"** projects are underway, supported by the European Battery Alliance. ZDM platforms like openZDM can help ensure high yield and quality in battery cell production, which is critical for EV performance and safety. In total, there are approximately 82 distinct cell production locations (plants) in Europe when including smaller-scale factories and planned sites [7].
- **Steel and Metal Processing:** Europe's steel industry has an annual **turnover of around €215 billion**, producing approximately 146 million tons of steel per year. According to the latest data from EUROFER (the European Steel Association), the EU steel industry comprises more than **500 production sites across 22 Member States [8]**. Steel and metal parts (e.g. openZDM's pilot on steel suspension arms) are core to automotive and machinery supply chains. The sector is highly energy-intensive and competitive, so reducing defects and scrap can save costs and cut emissions. EU steel output rebounded strongly post-pandemic (the value of basic metals production jumped 42% from €788 billion in 2021 to €1 trillion in 2022) [9]. However, demand softened by 2024 due to higher energy costs, with output value dipping by 4.3% [10].

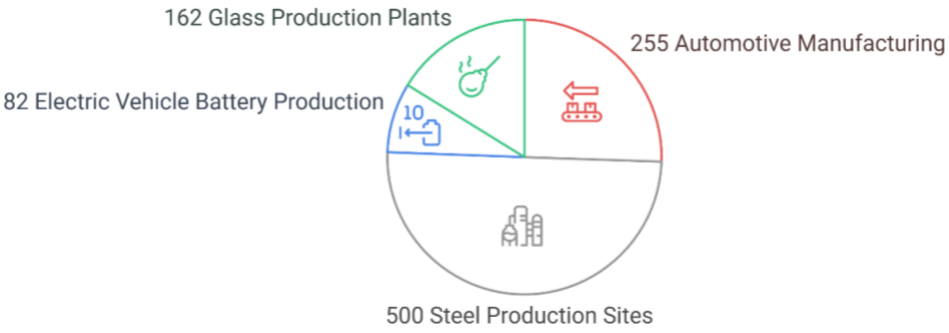


Figure 12: openZDM Market volume - manufacturing plans in Europe

- **Glass and Consumer Goods:** The EU is **the world's largest glass producer**, accounting for about **one-third of global glass output** [11]. Glass plants (e.g. container glass bottling lines in openZDM pilots) are energy-intensive and benefit from real-time defect detection to minimise waste. The European household appliances ("white goods") market is also significant – estimated at around **€90 - 110 billion** in annual sales in the mid-2020s, with steady growth (almost 4% CAGR). According to FEVE (the European Container Glass Federation), there are 162 container glass factories across 23 European countries [12].
- **Other high-value manufacturing segments (aerospace and pharma):** Sectors like aerospace, pharmaceuticals, and medical devices are highly regulated and quality-critical, offering expansion potential for openZDM. Europe's **aerospace & defence industry** had a **turnover of €260.5 billion in 2022** [13]. Zero-defect processes are vital in aeronautics for safety-critical components. The **pharmaceutical industry** is another segment since the EU was the world's **largest exporter of pharma products with €538 billion in exports in 2022** [14]. The pharma domain demands near-zero defect rates to ensure efficacy and compliance with regulations.

ZDM market trends

EU policy (Industry 4.0, Digital Europe, Green Deal, AI Act) is pushing factories towards digitalisation, real-time quality control and energy/resource efficiency, which is a lever for openZDM. European manufacturing is undergoing a big shift toward Industry 4.0, driven by the need for higher product complexity, customisation, and global competitiveness [15]. Over the past decade, the adoption of IoT connectivity, automation systems, cloud analytics, and AI has accelerated significantly, transforming factory operations across the continent. Between 2009 and 2023, the number of European firms active in advanced manufacturing more than doubled (i.e., from 1,900 to over 4,500 companies) [16], overtaking comparative growth in the United States. At the same time, digital twin technologies have become central to this transition, offering real-time virtual representations of production processes. Moreover, AI and ML are at every stage of production, enabling predictive maintenance, automated

visual inspection, and process optimisation. In 2024, AI combined with edge computing emerged as one of the dominant trends on European factory floors, allowing real-time quality insights with minimal latency. Research communities across Europe are actively advancing AI-driven digital twins and in-line inspection systems that can autonomously detect deviations and adapt processes in real time to avoid quality losses [17].

Sustainability has become a powerful driver of technological adoption, intensified by EU policies such as the European Green Deal. Manufacturers are under increasing pressure to reduce environmental impact, improve energy efficiency, and minimise raw material usage. Zero-defect manufacturing directly supports these objectives by reducing scrap, rework, and unnecessary consumption of resources. Every avoided defect translates into lower energy usage per good product, less production waste, and fewer emissions associated with recycling or disposal.

Finally, recent global disruptions (including the COVID-19 pandemic and shifting geopolitical dynamics) have exposed the fragility of international supply chains. European manufacturers are responding by reshoring critical production and diversifying suppliers. In this context, ZDM solutions offer significant value by enabling end-to-end quality assurance and better traceability across multi-tier supplier networks. As Europe scales up domestic production of strategic goods such as semiconductors and batteries, the ability to support operations with zero defects from the outset is crucial for securing competitiveness against long-established global players.

3.6.3 SWOT Analysis

Based on the market analysis and technical capabilities of the platform, a SWOT analysis is presented in Table 11.

Table 11: openZDM Integrated Platform SWOT Analysis

INTERNAL FACTORS

STRENGTHS +	WEAKNESSES –
• Integrates digital twins, predictive analytics, in-line NDIs and AI-driven decision support into one platform, providing full defect-prevention loops instead of isolated tools. • Established players in the governance model, which will support connections with customers and vendors. • Demonstrated support to quality improvement, enhanced traceability, and improved process visibility based on the integrated toolset. • Microservices and open APIs support and cloud/edge deployment allow fast integration and lower engineering costs for OEMs and integrators.	• Joint IP and tool-specific ownership might complicate licensing and long-term maintenance; alleviated by the IPR agreement. • High heterogeneity of legacy systems means each deployment needs engineering adaptation despite standardisation efforts. • MVP-level maturity; further refinement and industrial hardening of interfaces, documentation, and user flows will be required for large-scale adoption.

EXTERNAL FACTORS

OPPORTUNITIES +	THREATS –
• Increasing digital twin deployments, AI-driven quality analytics, and edge computing adoption create demand for integrated ZDM platforms. • EU Green Deal, Circular Economy, and energy-efficiency requirements favor similar platforms. • Factories struggle with fragmented systems; AAS-based solutions have strong strategic relevance. • Follow-up funding programmes can accelerate adoption via funded pilot replications.	• Deploying a platform that collects industrial data requires strong cybersecurity assurances and compliance with NIS2 directives/ any gap limits market trust. • Industrial players may delay major digital transformation investments, preferring incremental upgrades over platform-wide deployments.

3.6.4 Target Customers

The primary target markets for openZDM consist of:

- **Manufacturing OEMs** in automotive, steel, glass, wood panels, and battery production are aiming to achieve zero defects and reduce rework, scrap, and energy costs.
- **Tier 1 suppliers** with high process variability and strict OEM quality requirements, where early defect detection and predictive analytics have a direct financial impact.

The company types that will be targeted as initial adopters/ customers by the platform after the end of openZDM are:

- **Automotive manufacturers (Cars):** Automotive OEM vehicle assembly plants**,** Tier 1 suppliers producing body parts, chassis components, and interior assemblies**,** Tier 1 quality-inspection and metrology suppliers supporting OEM production lines.
- **Steel and heavy metals processing companies:** Manufacturers of metal structural components and suspension systems, steel mills and forging plants.
- **Glass container manufacturers:** industrial glass bottle producers**,** hot-end forming plants requiring real-time thickness and gob control.
- **Wood panels and furniture material manufacturers:** wood-based panel manufacturers (MDF, HDF, decorative boards), furniture material producers using continuous press lines
- **EV Battery Modules & Electronics Assembly:** EV battery module assembly lines**,** electronics-welding and laser-welding production facilities**,** and Tier 1 suppliers manufacturing battery cells or welded subcomponents.

3.6.5 Management Team of the openZDM integrated platform/ Governance structure

To support the sustainability of the platform, openZDM partners have established a governance framework with specific roles and key technical functions. The key functions identified include: system integration and platform infrastructure management; technical coordination for digital twin and decision-support services; data analytics service provision; user engagement and outreach functions, supporting early-adopter engagement, and communication of platform capabilities; and academic dissemination and further research. The framework relies on the principles established in the project's IPR Agreement, which defines ownership, access rights, and protection measures for the individual components and ensures transparent collaboration among contributors.

3.6.6 The business model and marketing strategy

Since the openZDM integrated platform has a modular and open architecture, from a business model point of view, it can be deployed/ sustained as a configurable suite of interoperable digital tools (digital twins, analytics services, inspection data connectors, and decision-support capabilities). Specific platform bundles can be combined into sector-specific configurations, which will reflect the use-case deployments demonstrated during the project. From a service perspective, the platform can be offered as a software solution (via new agreements and service contracts), which enables secure real-time process monitoring and predictive quality assessment. Depending on the end-user requirements, additional services (like configuration support, development of new features) can complement the core offering.

3.6.7 The operative plan

Based on the Booster workshop discussion, the operative model for the openZDM platform is structured around four core activity domains (Design, Operations, Sales, and Communication) with partner roles aligned to their technical contributions. Within the design domain, activities focus on the refinement of the platform's digital components and their adaptation to different industrial sectors. The operations and sales domains cover activities related to deployment support, maintenance of the platform infrastructure, and configuration of the digital components to meet the needs of various industrial environments. The communication and outreach domain focuses on disseminating the platform via demonstrators and participation in industrial or research events.

3.6.8 Financials

A conceptual analysis was also conducted to explore how a digital platform such as openZDM could be sustained beyond the project. The exercise examined typical financial considerations relevant to industrial software platforms, focusing on the types of revenues and activities that would be required for long-term continuity. The

work also identified the main categories of resources typically needed to sustain and evolve such a platform over time. These include technical expertise for ongoing development and maintenance, infrastructure for hosting and monitoring the platform, organisational capacity for coordination and roadmap management, and outreach activities to ensure alignment with industrial developments. The purpose of this assessment was not directly to establish a commercial plan, but to outline the practical elements that could support the long-term viability of an integrated manufacturing platform such as openZDM.

3.7 Go-to-Market Scenarios for the Exploitable Results

The Sections below present the distinct exploitation channels envisioned by project partners for the (i) separate exploitation of the platform's services, separately, as well as the exploitation plans of the openZDM NDIs.

3.7.1 Exploitation Models for the Software Components of the platform

Beyond the integrated platform, several of the software components developed in openZDM have potential for further use as standalone digital tools. These include modules related to digital twins, decision support, and data analytics, which can be adapted or extended for different industrial or research contexts. These solutions can be further refined, tested, or incorporated into broader digitalisation initiatives in manufacturing. Many of these solutions may also continue to evolve via new research collaborations, industrial pilot activities, or by being used to inform academic/ training programmes.

3.7.2 Exploitation Models for the NDIs

Across the consortium, the exploitation vision for the openZDM NDI portfolio is around three complementary pathways: (i) direct industrial deployment in the pilot sectors where the NDIs have already demonstrated TRL advancement, (ii) further commercialisation as stand-alone hardware/software inspection products tailored to specific verticals, and (iii) integration into broader ZDM service offerings via the openZDM platform. Partners responsible for each NDI foresee continued exploitation via use-case expansion, leveraging the strong validation achieved in steel, automotive, glass, wood and EV-battery manufacturing environments. openZDM industrial partners highlighted specific interest in systems that enhance productivity and first-pass yield, while several respondents reported measurable gains during pilot operation, including faster cycle times, improved thermal uniformity, and early defect detection. NDIs could be offered either as licensed hardware/software packages, embedded in service contracts (maintenance, calibration, analytics), or integrated as components of ZDM solutions co-delivered with the openZDM platform.

3.8 openZDM IPR agreement on the Exploitable Results

This part provides a high-level overview of the intellectual property framework (agreement) established within the project to support the long-term sustainability of the openZDM results. The framework clarifies general principles related to ownership of results developed in the project, access rights for further research and development, and the conditions under which jointly created results may be used after the project's completion. It basically complements the provisions already defined in the Grant Agreement and Consortium Agreement and provides additional guidance on how the outcomes of openZDM may be managed in future collaborative contexts. The framework sets out common definitions, describes how background and foreground knowledge are treated, and outlines general considerations for cooperation among partners when results are jointly generated. It also provides guidance on how IP may be protected and how partners may continue using the results.

4. Standardisation activities

Standardisation is a crucial process for modern industrial projects, ensuring that research and development outcomes are interoperable, reusable, and capable of seamless integration with both existing industrial technologies and future digital manufacturing frameworks. Standardisation acts as an essential bridge between project innovation and broad market adoption.

In the openZDM project, the dedicated standardisation efforts were concentrated within Task 6.3, spanning from Month 19 through Month 42. This work aimed to accelerate the practical uptake of Zero Defects Manufacturing (ZDM) concepts and tools developed within the project by aligning them with established industry protocols.

This deliverable follows up on the foundational activities reported in the previous deliverable, D6.2, and presents the definitive contributions and final achievements resulting from Task 6.3 over the entire implementation period.

The openZDM consortium has actively participated in and contributed to several high-impact standardisation developments, ensuring the project's intellectual assets are disseminated and utilised globally. The primary contributions include:

- Zero Defects Manufacturing (ZDM) Framework: Significant contributions were made to the definition and structure of the ZDM ecosystem via active participation in CEN/CENELEC working groups, helping to shape the European approach to ZDM standards.
- Machine Vision Standardisation: A formal proposal was submitted for the standardisation of key properties and parameters related to machine vision systems. This aims to improve the consistency and reliability of data exchange for quality inspection across different manufacturing environments.

These efforts cement the project's commitment to creating lasting impact beyond its duration, providing robust, standardised foundations for future Zero Defects initiatives across European industry.

4.1 Methodology

The following methodology has been used to carry out the standardisation activities:

- **Definition of objectives**: Use industry standards in the development of project solutions, and based on the experience gained in openZDM, actively contribute to the development and improvement of standards related to the "Asset Management Framework Structure" and zero-defect manufacturing.
- **Identification and analysis of existing standards**: The openZDM project focuses on two main topics of interest: **Zero Defect Manufacturing**, and **Asset Administration Shell** (Platform based on AAS). In the case of Zero Defect Manufacturing, it was identified that a working group outside the openZDM project created a CWA - CEN Workshop Agreement – to define a vocabulary and basic principles of zero defect manufacturing.

Regarding RAMI 4.0 and AAS, the former is a standard, and the latter is undergoing a standardisation process. However, AAS modelling seemed to present an opportunity to propose the standardisation of AAS submodels to enable interoperable data sharing. Initially, efforts were directed towards the standardisation of the submodel to describe the technical data of Non-Destructive Inspection systems (NDIs) based on machine vision systems. To this end, the VDMA 40100-1 and VDI/VDE/VDMA 2632 standards have been identified, both of which are focused on machine vision systems. After evaluating them, the VDI/VDE/VDMA 2632 standard was chosen as the guideline for the proposed standardisation of the technical data submodel because it provides a definition of concepts that allows describing the composition of the machine vision system. Based on the experience of using a standard for the description of technical properties of NDIs based on Machine Vision Systems developed in the project, we wanted to extend this task to all other NDIs. However, this was not possible due to the absence of industrial standards that define vocabularies for the technologies underlying the NDIs developed in openZDM.

4.2 Contribution to Standardisation developments

The execution of the standardisation strategy and the specific partner effort during M24-M42 focused on CEN Workshop Agreement (CWA) 18230:2025 and a proposal for the standardisation of properties for machine vision systems, as described below in more detail.

4.2.1 CWA 18230:2025 "Zero Defects Manufacturing – Basic Principles and Requirements"

Members of the openZDM project actively contributed for 18 months to the CEN/CENELEC ZDM Vocabulary and Basic Principles workshop, which developed the CEN Workshop Agreement (CWA) 18230:2025: "Zero Defect Manufacturing: Basic Principles and Requirements." This CWA defines: a) the basic principles and methodologies for implementing ZDM, the requirements for ZDM, and b) specifies the minimum technical, organisational, and process requirements for effectively adopting ZDM methodologies. c) Proposes a comprehensive evaluation system to assess and certify manufacturers based on their adherence to ZDM and their level of operational maturity.

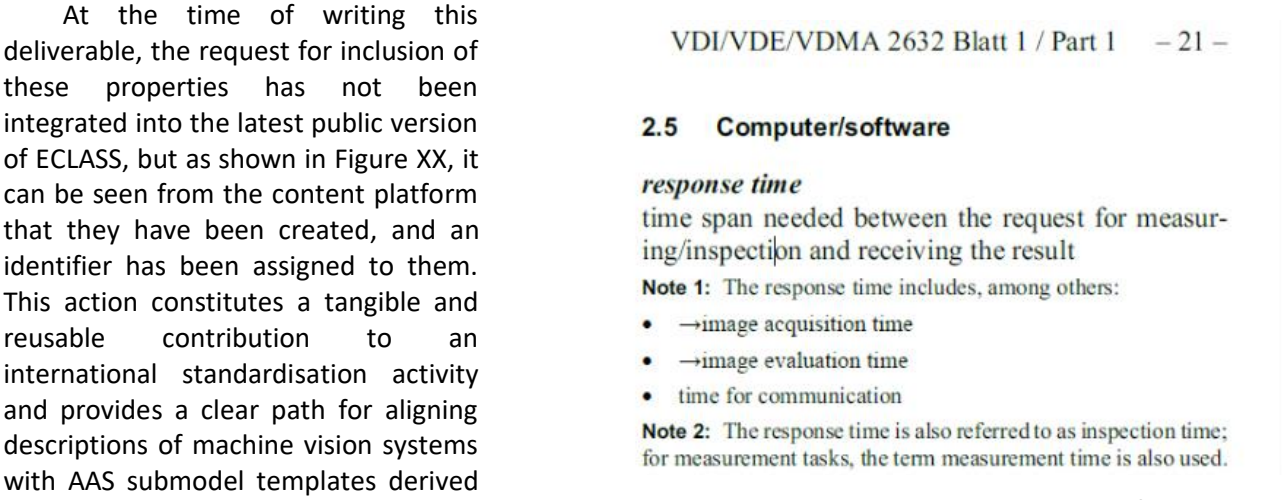
4.2.2 Proposal for the standardisation of properties for machine vision systems

A second contribution of the project was the proposal for the standardisation of properties for the description of Machine Vision Systems equipment. The original idea was to create a submodel for this description; however, when

it was proposed to the IDTA, the idea was rejected, given that IDTA considers that a submodel for the "generic" description of industrial equipment already exists. Faced with this rejection, we were redirected to ECLASS to propose the standardisation of the properties that describe Machine Vision Systems, rather than a technical data submodel for them. ECLASS provides a language-independent description of products and services, organised into product classes with associated sets of properties, and collaborates with the IDTA in the process of standardising submodels, since the properties that make up the templates use the identification system provided by ECLASS. Therefore, ECLASS is a key player in interoperability in Industry 4.0.

For this contribution, the VDI/VED 2632 standard was used (Figure 13), since this standard proposes a specific set of classes and descriptive properties of products for industrial machine vision systems, particularly those used for non-destructive inspection in ZDM scenarios. Specifically, this standard attempts to bridge the semantic gap between customer requirements for the machine vision system they need and the technical specifications provided by manufacturers. Then, by mapping requirements and specifications, a list of properties required to describe Machine Vision Systems was created. The proposed properties cover key aspects such as optical configuration, lighting, sensor characteristics, processing capabilities, and inspection tasks, with the aim of enabling a standardised, machine-readable description of machine vision systems within the ECLASS hierarchy (Figure 14).

At the time of writing this deliverable, the request for inclusion of these properties has not been integrated into the latest public version of ECLASS, but as shown in Figure XX, it can be seen from the content platform that they have been created, and an identifier has been assigned to them. This action constitutes a tangible and reusable contribution to an international standardisation activity and provides a clear path for aligning descriptions of machine vision systems with AAS submodel templates derived from industry standards. Once the new version of ECLASS (ECLASS 16.0) is released, the goal is to extend the version of the technical data submodel template with the properties standardised by ECLASS for the Machine Vision System.



VDI/VDE/VDMA 2632 Blatt 1 / Part 1 – 21 –

2.5 Computer/software

response time

time span needed between the request for measuring/inspection and receiving the result

Note 1: The response time includes, among others:

- →image acquisition time
- →image evaluation time
- time for communication

Note 2: The response time is also referred to as inspection time; for measurement tasks, the term measurement time is also used.

Figure 13: Definition of Response Time concept in VDI/VDE 2632 Standard

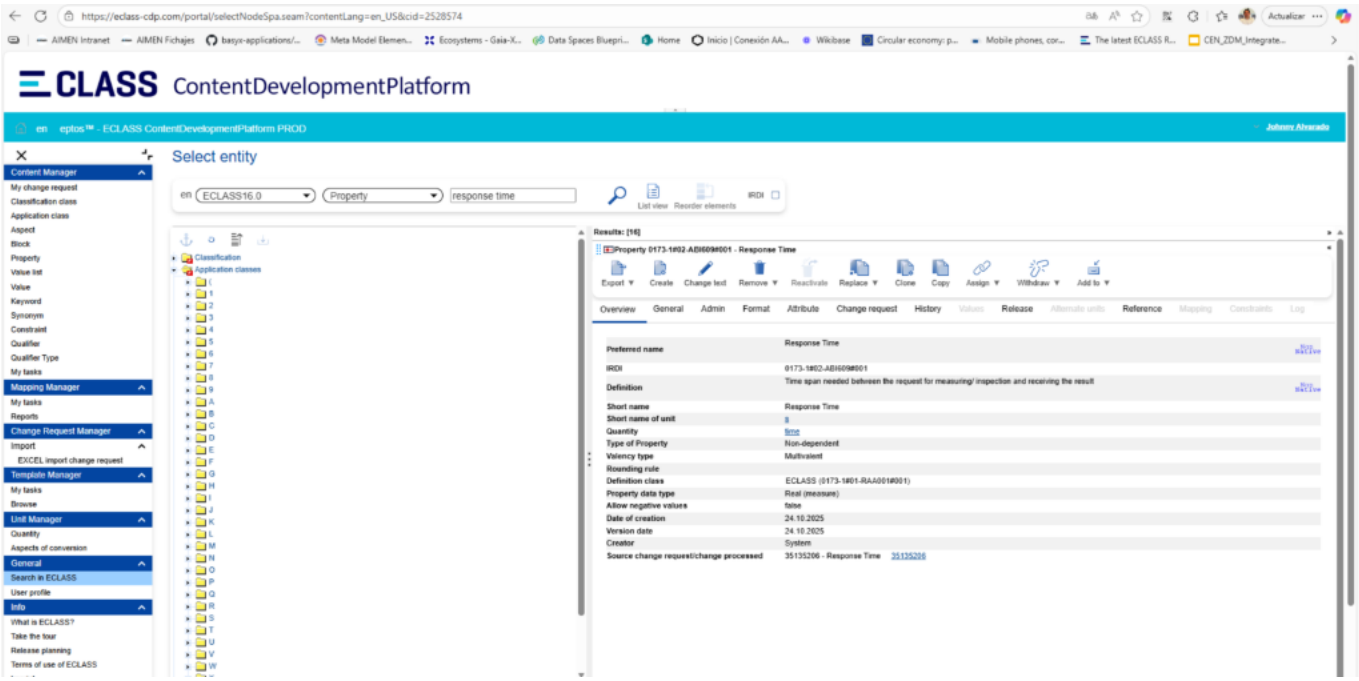


Figure 14: Standardization of Response Time in ECLASS Dictionary (version 16.0 pending to release)

4.3 Lessons learned and future outlook

During the execution of the project's standardisation activities, several important lessons were learned:

I. **AAS Submodel Template Generation Challenges:**
   a. The current standardisation of AAS submodel templates is primarily based on use cases, which limits their full domain interoperability.
   b. A significant gap exists due to the lack of industry standards that define comprehensive domain vocabularies, making the creation of fully standards-based submodels currently unfeasible for all assets.
   c. Extracting concept definitions from existing standards is highly time-consuming, which can reduce the motivation of template designers to use them. Furthermore, inconsistencies often found within standards can lead to conceptual confusion.
   d. openZDM's Proposed Solution: To address this, the project proposes carrying out UML conceptualisations of industry standards as a necessary starting point for defining AAS submodel templates. This is a first step toward closing the data gap and maximising the standardised portion of the domain.
   e. As part of the standardisation tasks, we developed a set of transformation rules for converting these UML conceptual models of industry standards into instances of the AAS metamodel, significantly reducing the manual effort and time required for template generation.

II. **Engagement and Timeframe Difficulties:**
   a. There was a notable difficulty in achieving sustained engagement with dedicated standardisation groups. Initial contact with groups focused on digital twins and platforms often did not yield a response.
   b. The timeframe for obtaining official results in this area is protracted. For example, the proposal for the standardisation of properties presented to ECLASS in October of last year has not yet been included in an official release, demonstrating the long lead times involved.

In summary, the standardisation activities within openZDM, while yielding tangible and recognised contributions, have underscored the complexity of achieving comprehensive domain interoperability via current AAS practices and confirmed the protracted engagement timelines inherent to formal standardisation bodies. The central strategic takeaway is the necessity of a structured, model-driven approach. Moving forward, the openZDM consortium will champion the adoption of the proposed UML conceptualisation and transformation rules as a method to systematise standard interpretation, thereby simplifying template generation and maximising the standardised portion of digital asset descriptions. These lessons provide a robust foundation for future European projects aiming for standardisation impact, emphasising that early, sustained, and methodologically sound engagement is vital to navigating the complexities of the industrial digitalisation landscape.

5. Conclusions

During the openZDM project, exploitation, communication and dissemination, and standardisation activities were closely interlinked and collectively expanded the impact of the project's technical achievements. Communication and dissemination supported the broad visibility and stakeholder awareness, creating the necessary market pull and industrial engagement that fed directly into the exploitation strategy. In parallel, the exploitation work translated technical outputs into concrete business models, service bundles, and adoption pathways, transforming research results into business models for industrial solutions. The standardisation efforts (basically around AAS modelling, ZDM principles, and interoperability), guaranteed that the technical components of the platform aligned with emerging European frameworks, thereby increasing their readiness for integration across diverse manufacturing environments. These three pillars supported the project's alignment with wider EU priorities such as digital transformation, industrial resilience, sustainable and zero-defect production, and the advancement of interoperable, data-driven manufacturing systems under the Industry 4.0/5.0 agenda. The detailed achievements per pillar (as was described in detail in this deliverable) are reported below.

Communication & Dissemination Achievements

- **Exceeded most communication KPIs**, including social media impressions, newsletters issued, DIH outreach, event participation, and external blog publications.
- **Rebranded and optimised the project website**, supported by SEO improvements and intensified content development, resulting in stronger engagement in the final project months.

- **Achieved strong visibility through industrial and scientific events**, including AUTOMATICA, ETFA, ADRF24, and targeted workshops across Europe.
- **Produced 19 high-quality videos** and extensive communication material (flyers, roll-ups, brochures) far beyond initial targets.
- **Built an active LinkedIn community** of 740 stakeholders (engineers, researchers, OEM/Tier 1 professionals), prioritising targeted reach over volume.
- **Established 11 project liaisons and 3 cluster engagements**, strengthening networking and cross-project knowledge exchange.

Exploitation Achievements

- **Defined a final list of 18 Exploitable Results**, covering the integrated platform, NDIs, data analytics, Digital Twins, decision-support tools, and middleware components.
- **Developed individual exploitation paths for all partners**, outlining concrete commercial, research, and technical reuse actions post-project.
- **Completed exploitation strategy and business plan** for the openZDM integrated platform, including market analysis, competitive positioning, revenue models, and financial scenarios.
- The **platform governance model and business model established**, defining joint ownership rules for service bundles, partner roles in design/operations/sales, and the commercial exploitation setup where INTRA acts as the primary licensing and customer-facing integrator for the openZDM platform.
- Service Bundle commercialisation model introduced, enabling the platform to be offered to industry via sector-specific bundles (automotive assembly, steel processing, glass, wood panels, EV batteries).
- **Leveraged Horizon Results Booster (Modules B & C)** to refine value propositions, market segmentation, risk analysis & exploitation roadmaps for the portable laser line triangulation sensor and the integrated platform.
- **Business Plan and financial projections designed** for the platform, including licensing fees, service contracts, market scenarios, and operational cost models for a sustainable post-project phase.
- **Concluded on some commonly accepted provisions for the jointly owned results (IPR Agreement)**, clarifying ownership, background IP, exploitation rights, licensing rules, and post-project responsibilities.

Standardisation Achievements

- **Contributed to European ZDM standardisation efforts**, including **CWA 18230:2025** "Zero Defects Manufacturing – Basic Principles and Requirements."
- **Advanced AAS-related standardisation**, proposing structured properties for machine vision systems and contributing to the ECLASS dictionary (response time definitions).
- **Aligned platform architecture with RAMI 4.0 and IEC 63278-1**, for interoperability & industry adoption.
- Documented lessons learned for future standardisation work, highlighting gaps in AAS modelling, semantic interoperability needs, and recommendations for next-phase EU initiatives.

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