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Type		
R	Document, report (excluding the periodic and final reports)	x
DEM	Demonstrator, pilot, prototype, plan designs	
DEC	Websites, patents filling, press & media actions, videos, etc	
DATA	Data sets, microdata, etc	
DMP	Data management plan	
ETHICS	Deliverables related to ethics issues	
SECURITY	Deliverable related to security issues	
OTHER	Software, technical diagram, algorithms, models, etc	

Dissemination level		
PU	Public, fully open, e.g. project website	
SEN	Sensitive, limited under the conditions of the Grant Agreement	x
Classified R-UE/EU-R	EU RESTRICTED under the Commission Decision No2015/444	

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HISTORY OF CHANGES

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TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

AB	Advisory Board
AI	Artificial Intelligence
COMM	Commercialisation
IIoT	Industrial Internet of Things
KER	Key Exploitable Results
KG	Knowledge Generation
KPIs	Key performance Indicators
MaaS	Manufacturing as a Service
ML	Machine Learning
NDA	Non-Disclosure Agreement
OEM	Original Equipment Manufacturer
SME	Small and Medium-Sized Enterprise
TRL	Technology Readiness Level

1. Executive summary

This deliverable sets the initial exploitation plans of Lasers4MaaS. We include the first strategy for the development of a business model which will allow the exploitation of the results obtained during the project, facilitate the adoption of the digital servitisation of manufacturing based on laser processes by companies from different industrial sectors and ensure the future sustainability of the project. An updated and consolidated version will be presented in D19.3 (final report of exploitation strategy and market penetration).

2. Introduction and strategy

Lasers4MaaS will integrate advanced manufacturing solutions and digital platforms. Initial demonstrated for the laser welding industry, the project outputs can be translated across sectors for enhanced control, efficiency, and quality. By integrating industry 4.0 technologies such as IIoT, AI, and big data analytics, laser welding processes are becoming increasingly automated and optimized. Digital platforms enable real-time monitoring of welding parameters, ensuring precise adjustments are made instantly to improve weld quality and consistency. Predictive maintenance tools, powered by data analytics, allow manufacturers to anticipate equipment failures and minimize downtime, enhancing productivity. Additionally, digital solutions facilitate seamless integration of laser welding systems with other parts of the production line, streamlining workflows and improving overall manufacturing efficiency. Digital twins of welding systems enable virtual simulations, helping manufacturers test and refine their processes before actual production, reducing errors and material waste. The combination of laser welding technology and digital manufacturing platforms not only improves the speed and accuracy of welding but also drives greater sustainability by optimizing resource usage and reducing waste, making it a key component in modern smart factories.
The following sections discuss: (A) target markets and size with customers' needs; (B) key exploitable results (KERs) - a list of KERs has been identified at month 3 of the project and during the project lifetime, new KERs may be discovered while identified KERs may be dropped; (C) competitive advantages and unique market proposition; (D) summary of actions to reach higher TRL (> 6); (E) potential revenue streams with enhanced market opportunities for the project partners; (F) exploitation plans of project partners with specific actions to reach higher TRL (> 6).

2.1 Target markets, size and dynamics

Target markets with size and dynamics are discussed in Table 1.

Table 1: Target markets and size with related dynamics and barriers/needs

Target market: *Digital platforms segment*
Market size and dynamics: businesses are increasingly leveraging digital platforms and services to improve their operations, enhance customer experiences, and create new revenue opportunities. The development of this market will be influenced by several key trends: increased adoption of cloud-based solutions, the rise of ML/AI, the growing importance of data analytics, and advancements in technologies such as IIoT and high-speed wireless communication protocols (5G, etc.), but also advanced manufacturing processes such as laser welding. However, the market also faces challenges, such as data security and privacy concerns, regulatory compliance issues, and the need for skilled professionals to manage and implement digital platforms and services. Overall, the market for digital platforms and services is set for robust growth in the coming years, driven by the increasing digitalisation of businesses and industries worldwide. The global market for digital platforms and services is rapidly growing. In 2022, the market value was estimated at €1.3 trillion, according to Gartner; this figure is expected to grow to €1.6 trillion by 2025, according to the international data corporation (IDC)[1].
Needs: boost in service platforms by digital transition and need for IIoT solutions with fast/secure data sharing.
Target market: *Laser welding segment and manufactures of battery systems for e-mobility*
Market size and dynamics: the global laser welding market size was valued at €1.96 billion in 2021 and is projected to grow from €1.85 billion in 2022 to €2.55 billion by 2030[2]. According to the most recent numbers by Allied Market Research, Asia-Pacific has the highest share in laser welding system market, due to extensive demand in the electronics segment. However, EU market is projected to have significant growth with a noteworthy upsurge in the coming years pushed the established automotive sector in EU and the current transition towards electrification – estimated at €5-7 billion market for battery manufacturing equipment (welding covers 28% of the segment) by 2025[3]. Simultaneously, the project

[1]https://www.gartner.com/en/newsroom/press-releases/2022-02-09-gartner-says-more-than-half-of-enterprise-it-spending
[2]*Allied Market Research, "Laser Welding System Market Size, Share, Growth Outlook", 2025*
[3]*McKinsey research report, "Unlocking the growth opportunity in battery manufacturing equipment", 2022*

plan to spearhead the digital servitisation wave in manufacturing by enriching laser welding systems/stations with advanced data analytics, ML/AI, and remote monitoring capabilities from the Lasers4MaaS platform, with the aim to offer all-encompassing “Laser-as-a-Service” packages. This will not only maximise customer value but also ensures the generation of recurring revenue streams.
Needs: boost in EV markets and need for cost reduction, variation in production volumes and demand for zero-defect and zero-waste manufacturing approaches. Manufacturers, especially SMEs, struggle to harness the full potential of laser welding machines for on-demand production due to a productivity-focused approach jeopardising flexibility. Growing market pressure or mass customisation prompts the need for technologies enabling flexible and responsive production systems. Data security, privacy and regulation must be addressed, together with the alignment to DPP, especially for battery manufacturing.
Target market: *Infrastructure development projects around the EU for fusion plants*
Market size and dynamics: this market demands innovative laser welding solutions to maximise accessibility in confined operations and unlock simplified tooling development; but also, remote maintenance to eliminate risks of failures associated to dangerous maintenance tasks. The fusion industry has now attracted over €5.5 billion in investment, with 27 companies increase their funding levels in 2023[4]. Several opportunities do exist in the Fusion Supply chains, which are also relevant to other fusion adjacent sectors. Welding tools and prototypes are a subset of these - for instance, only in 2023, €2.4 million was spent on Contract Engineering in the Fusion supply chain[5].
Needs: develop new welding tools/prototypes using advanced laser welding technology for fusion environment. Enable market diversification from relevant fusion adjacent sectors for welding tools, thus increasing the value chain. Provide capability to design, deliver, and operate commercial fusion power plants.
Target market: *Manufactures of fuel cells and hydrogen storage systems*
Market size and dynamics: production at scale of hydrogen fuel cells/bipolar plates and storage units in the transportation sector, including aerospace, is subjected to a growth rate pushing the requirements for quality, reliability and lead-time. Cumulatively, this is responsible for the growing demand of innovative laser welding solutions - the global fuel cell market is estimated to growth from €3 billion up to €8 billion by 2028 (McKinsey research).
Needs: the welding procedure specifications are generally affected by normative standards, customer’s certifications and qualifications. Lasers4MaaS will foster standardisation procedures, certification and traceability. Need for high manufacturing flexibility, efficient manufacturing techniques, and agile supply chain.
Target market: *Pipe welding for packaging food machines*
Market size and dynamics: the rising demands to high quality welded tubes in food packaging machineries is boosting demands for laser welding technologies and overcome state-of-the-art welding process (either manual TIG or automated MIG/CMT) that necessitate rework activities up to 5% of the total operations time to meet the market regulations – filling and sealing machines characterise the packaging machinery industry with a share of almost 80% of all packaging machines produced and a share of more than two thirds in the value of all packaging machines produced; only in Italy, the turnover has reached €9 billion in 2023 (+6%) guided by the export (81%) with a +12% growth of the foreign markets (Allied Market Research).
Needs: the welding procedure specifications are generally affected by normative standards, customer’s certifications and qualifications. Industry’s struggle with interoperability, data exchange issues and the lack of standards hindering the seamless implementation of digital servitisation in manufacturing. High product diversification (production on-demand) and need for flexibility and high quality.
Target market: *Aerospace industry*
Market size and dynamics: Laser4MaaS has a significant impact on the ongoing transformation of the aeronautic/aerospace supply chain, necessitated by new industrial models. This transformation requires the construction of a robust and agile supply chain. The increasing orders are shifting production models (Airbus, Boeing) towards concentrating on assembly and outsourcing entire modules or submodules

[4] *The global fusion industry, “Fusion Companies Survey by the Fusion Industry Association”, 2023*
[5] *The Fusion Industry Supply Chain, “Opportunities and challenges, Fusion Industry Association”, 2025*

previously handled internally. This shift necessitates OEMs to accelerate and reinforce their purchasing processes and supply chain management, and to rebalance their risk profiles[6] towards a resilient MaaS models.
Needs: suppliers are increasingly pivotal in the development and innovation processes. They are now often tasked with managing complete modules and systems, a responsibility that demands handling increased complexity and vertical integration. This shift also requires these suppliers to become more deeply involved in R&D and innovation, driving them to expand beyond their core business areas. They are expected to augment their engineering capacities, foster new supplier relationships, and recruit skilled employees capable of developing comprehensive modules.

2.2 Key exploitable results

The results of Lasers4MaaS will lead to the KERs identified as follows: (1) digital platform with dashboard powered by generative AI; (2) predictive maintenance/remote monitoring; (3) process selector; (4) process optimiser; (5) process controller; (6) sustainability and cost evaluator; (7) access to the “Welding Process Analytics Database”. All these KERs are backed by advanced manufacturing technology including: (1) dynamic beam shaping; (2) jigless fixtures; (3) modular production schemes; and (4) solutions for data interoperability across company boundaries. The identified KERs are shown in Figure 1.

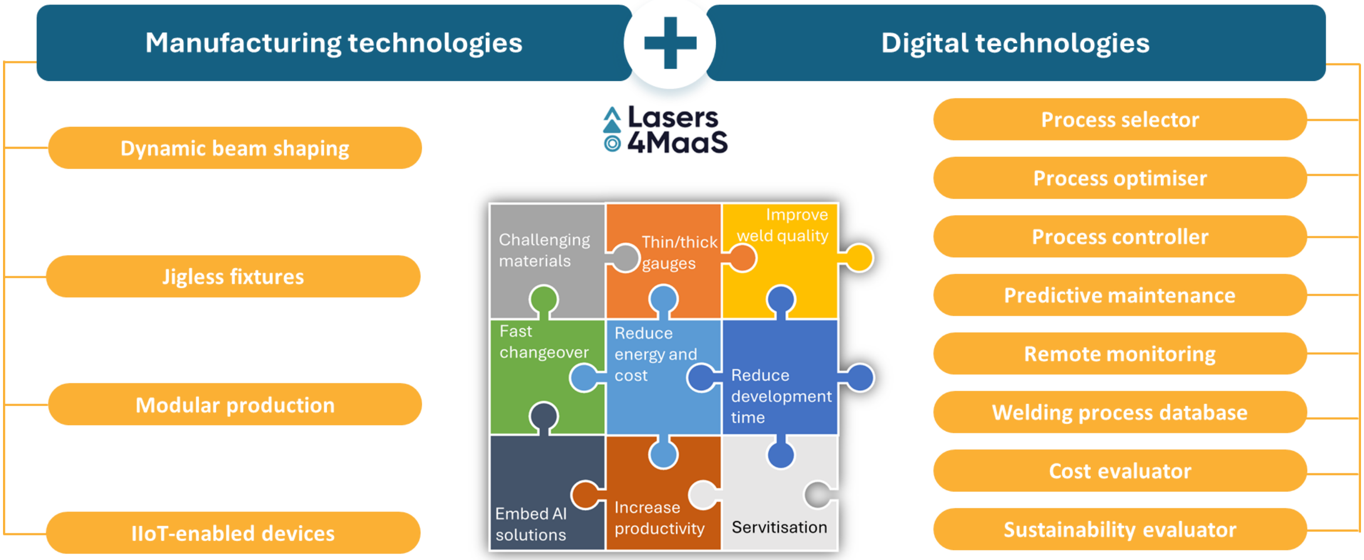

Figure 1: Lasers4MaaS’s platform combining manufacturing and digital technologies

2.3 Competitive advantages

The digital service platform will be a landing place for organisations which must address the transition to smart, decentralised and sustainable production. The Lasers4MaaS platform is designed to align closely with market needs, ensuring cost-effectiveness through scalability. It addresses the ***reconfigurability, connectivity, controllability and acceptance challenge*** in industry, making investments feasible for manufacturing-centric companies, particularly highlighting the financial constraints that often blocking SMEs from diversifying into expensive laser welding systems or associated state-of-the-art technologies. The platform will enable its users to (1) reconfigure manufacturing equipment; (2) safely share data and overcome concerns related to data security and interoperability; (3) maintain equipment, hence limiting failures and unscheduled maintenance/downtime by intelligent and smart reconfiguration of its units; (4) enable control and optimisation of virtual and real welding machine assets; (5) access sustainability, circularity and lowering costs. Three key competitive advantages have been identified: (1) **Digital Integration and Automation**: *Real-Time Production Planning*: implementing advanced digital platforms

[6] *O. Wyman, "CHALLENGES FOR EUROPEAN AEROSPACE SUPPLIERS," March & McLennan Company, 2015*

enables real-time production planning, optimising schedules, and resource allocation. This can significantly enhance efficiency, reduce downtime, and allow for dynamic adjustments to meet varying demand in different manufacturing sectors. *Quality Assurance*: leveraging digital twins for continuous monitoring and quality control. This ensures that each weld meets the stringent standards required in industries like aerospace and food machineries, providing a level of precision and consistency that traditional methods may struggle to achieve.
(2) **Customer-Centric Platform with Industry Expertise**: *Sector-Specific Customisation*: the platform offers specialised features and tools tailored to the unique requirements of each manufacturing sector. Understanding the specific needs of automotive, aerospace, fusion, food and hydrogen sectors allows to provide a more targeted and effective solution compared to one-size-fits-all approaches. *Expert Guidance*: Lasers4MaaS provides expert advice and support through the platform, offering insights into best practices and industry-specific guidelines. This can build trust among clients, especially in sectors where adherence to standards (aerospace and automotive) is critical.
(3) **Life-cycle Management**: *Process optimisation and control*: integrate advanced digital twin models with ML/AI to optimise and control complex laser welding processes and maintain, over-time, the desired quality targets, thus reducing reworks, recalls and costly down-time. *Equipment Monitoring*: utilise IIoT sensors and analytics to monitor the condition of welding equipment. Predictive maintenance algorithms can foresee potential issues, reducing unexpected downtime and extending the lifespan of equipment. This is crucial in industries with high precision requirements (aerospace food and fusion plant), where faulty conditions can have significant consequences. *Digital product passport*: Lasers4MaaS will contribute shaping the formation of the digital product passport, which can be used to champion device and materials sustainability across key sectors such as battery systems for e-vehicles.

2.4 Actions to reach higher TRL

This will be developed by technology licensing/patents in harmony with the other partners; follow-on grant towards IA (TRL 7); validation campaigns with consolidated customers and achieve their process/product certification (TRL 8); acquisition of technological awareness on the process and transferability to new products; marketing and commercial campaign focused on strategic new customers; private investment by company to reach TRL9 and above (MRL).

2.5 Revenue streams

Revenue streams can either be generated through the sale of the technology or licensing of it to relevant producers, but also new knowledge generation for advancements of research: direct B2B sales, penetrating suppliers and distributors, but also machine builders/integrators; direct B2C sales, penetrating end-users; direct revenues and cost saving due to improved production, quality of products/services and lead time.

Table 2: Identified revenue streams

Enhanced market opportunities for the project partners: the enhanced market opportunity for **FUTURICE** is driven by the ongoing digital transformation across all sectors (machinery and manufacturing included). Businesses are increasingly leveraging digital platforms and services to improve their operations, enhance customer experiences, and create new revenue opportunities. After successfully validating the Lasers4MaaS platform, FUTURICE will build the necessary data infrastructure and expects to increase their tech consulting and implementation revenue based on implementation engagement with new partners of the service and/or clients of the service. **ECOR**, leveraging new laser welding capabilities using dynamic beam shaping, expects to see growth within their current market of welding solutions across food packaging, aerospace and fuel cells, estimating an annual cost saving of €200k. This is the cumulative result from 25% productivity improvement (welding speed increment and easy reconfigurability of the prototype plant), reduced finishing time and 20% weld quality improvement (thanks to better welding penetration control) of pipe welding, heat exchangers and sterilising chambers - totaling €1 million over five years. Additional revenue projections (from 890k€ up to 7,3M€ in 5 years) include a significant increase in production of bipolar and connector plates (total of

3.500 -> 30.000 in 5-years according to its actual customer prevision). The marketing and commercial plans are considered to produce at least 2 additional customers in the sector with an incremental conservative estimated 1,95M€ turnover. Strategic vertical in-house integration in aerospace production, significantly increasing revenue and reducing outsourcing costs (for example, for space launchers parts currently impacts 70% for external welding. The calculated savings are 70k€/year). **CIVAN** targets an increase in sales of 5-to-10 dynamic laser beam shaping machines yearly within three years post-project, focusing 70% on EU countries and 30% on non-EU markets (USA, Japan, South Korea), projecting a total increase of €7 million. For **CORNAGLIA**, the competitive advantage related to the implementation of dynamic beam shaping for the production of large battery cooling plates for e-vehicles will allow to enter in the market achieving a potential market share between 1% and 5% of the global one. CORNAGLIA will have the opportunity to double his current turnover within 5-10 years post-project. Current barrier-to-market-entry for CORNAGLIA is the skill gap and capital outlay – a strategic partnership with ECOR could potentially be sought in the medium-term (discussions have started during the bid preparation) to reduce the capital investments and leverage/harvest the core benefits of Lasers4MaaS with distributed production models. This could be a win-to-win business move for ECOR/CORNAGLIA. The proposal will bridge also the knowledge gap about laser welding by a process optimisation carried out by sharing technological and industrial competences. Lasers4MaaS is set to **demonstrate the balance of the proposed solutions in terms of cost effectiveness by the development of a new "equivalent MaaS ROI"** considering 3 industrial areas: (1) Technology area: IIoT solutions (predictive maintenance/remote monitoring) and advanced laser welding via dynamic beam shaping measures by: reconfiguration/lead time; interoperability index; maintenance/monitoring index. (2) Operation area: process capability index; scrap rate; productivity index (welding speed; production volumes/rates); OEE (downtime for equipment failure; machine availability); (3) Business area: annual cost savings (driven by reduced process development time, improved process reconfigurability, etc.); annual revenues from productivity; annual savings from improved quality; capex investment (laser, robot, etc.); annual maintenance costs from IIoT solution; IIoT platform investment.

3. Exploitation plans of project partners

Table 2 shows a detailed breakdown of the exploitation plan for each project partner with Type of Exploitation (**KG**=Knowledge Generation, **COMM**=Commercialisation), and Target TRL in the short (project end) and long-term (5/10 years after project end).

Table 3: Exploitation plans of project partners

Partner: WMG (RD&T institution)
Exploitation assets: (1) In-process monitoring of laser weldments in confined areas. (2) Generation of the Welding Process Analytics Database. (3) Laser welding process development using dynamic beam shaping.
Type of Exploitation: KG via teaching and training at all levels to keep curriculum at latest state of research and provide students with real-world use cases. New research streams to support fusion engineering using laser-based technologies; but also explore new opportunity in "manufacturing in-space, beyond Earth" to support future space exploration missions. COMM via possibility of licensing and patenting the Lasers4MaaS's core methods and systems. **Approach to reach higher TRL (> 6)**: Establishment of new joint research activities with key industrial partners interested in dynamic beam shaping and advanced sensing technology for zero-defect and zero-waste, and smart manufacturing systems to run pilot studies. **Further investment to reach higher TRL (> 6)**: follow-on grant towards IA (TRL 7) and direct research contracts with industrial partners. **Target Groups**: RD&T institutions, OEMs/end-users, suppliers in the laser-based manufacturing sectors and sensor providers for in-process monitoring and control. **Target TRL:** Short-term: TRL 6. Long-term: TRL 7
Partner: USTUTT (RD&T institution)
Exploitation assets: Combined sensors and digital twin for real-time AI-based decision support.

Type of Exploitation: KG via teaching and training at all levels to keep curriculum at latest state of research and provide students with real-world use cases. Further develop X-ray-as-a-service for in-process quality inspection, and not only for process development and optimisation. **Approach to reach higher TRL (> 6)**: Establishment of new joint research activities in the area of physics-informed ML/AI across the laser-material processing ecosystems. **Further investment to reach higher TRL (> 6)**: follow-on grant towards IA (TRL 7) and direct research contracts with industrial partners. **Target Groups**: RD&T institutions, suppliers in the laser-based manufacturing sectors. **Target TRL:** Short-term: TRL 6 (2028). Long-term: TRL 7 (2030)
Partner: ULEI (RD&T institution)
Exploitation assets: Decision support based on performance, cost, sustainability and circularity assessment.
Type of Exploitation: KG via teaching and training at all levels to keep curriculum at latest state of research and provide students with real-world use cases. Integration of Lasers4MaaS protocols for harmonised gathering of data suitable for life cycle inventories in leading LCA software (e.g., Activity Browser, Brightway, OpenLCA). **Approach to reach higher TRL (> 6)**: Extension of Lasers4MaaS decision support capabilities for sustainability and circularity assessment in leading LCA software (e.g., Activity Browser, Brightway, OpenLCA). **Further investment to reach higher TRL (> 6)**: follow-on grant towards IA (TRL 7) and direct research contracts with industrial partners. **Target Groups**: RD&T institutions, LCA software developers/consultants. **Target TRL:** Short-term: TRL 6 (2028). Long-term: TRL 7 (2030).
Partner: TUW (RD&T institution)
Exploitation assets: Physics-based digital twin model development.
Type of Exploitation: KG via teaching and training at all levels to keep curriculum at latest state of research and provide students with real-world use cases. Improvement of modelling and simulation capabilities for laser welding to be leveraged in future contract research projects with industrial partners. Development of know-how in reduced order modelling of laser-based processes to diversify and broaden TUW's research portfolio and incept new R&I activities. Adaptation of simulation software towards interoperability standards for seamless integration with other software tools in future projects. **Approach to reach higher TRL (> 6)**: Establishment of new joint research activities in the area of real-time physics-based digital twin model development, application to laser welding/cutting and additive manufacturing. **Further investment to reach higher TRL (> 6)**: follow-on grant towards IA (TRL 7) and direct research contracts with industrial partners. **Target Groups**: RD&T institutions, CAE simulation companies. **Target TRL:** Short-term: TRL 6 (2028). Long-term: TRL 7 (2030).
Partner: CIVAN (technology provider)
Exploitation assets: Dynamic beam shaping empowered by Laser-as-a-Service package.
Type of Exploitation: COMM via increased revenue and B2B/B2C sales. **Approach to reach higher TRL (> 6)**: (1) To enhance the market presence, the strategic plan entails utilising the achievements of Lasers4MaaS, specifically in areas such as e-mobility and fusion energy, to forge essential partnerships within designated sectors. This strategic move aims to drive sales and enhance market share through the delivery of tailored, integrated laser solutions. (2) To spearhead the digital servitisation wave in manufacturing - by enriching the CIVAN laser systems with advanced AI, and remote monitoring capabilities from the Lasers4MaaS platform, CIVAN intend to offer all-encompassing "Laser-as-a-Service" packages. This not only maximises customer value but also ensures the generation of recurring revenue streams. **Further investment to reach higher TRL (> 6)**: private investment by company to reach TRL9 and above (MRL). **Target Groups**: OEMs/end-users for low-mix high-volume and high-mix low-volume productions. **Target TRL:** Short-term: TRL 6 (2028). Long-term: TRL 9 (2030)
Partner: RACE (end-user)
Exploitation assets: new welding tools using advanced laser welding technology for fusion environment.
Type of Exploitation: KG of novel solutions for in-bore welding. COMM via licensing/patenting. **Approach to reach higher TRL (> 6)**: (1) Establishment of codes and standards, as well as procedures, for welding of fusion reactor components. (2) Market penetration can be enabled through application in fusion and relevant fusion adjacent economic sectors (e.g. aerospace application) using RACE. (3)

Development of the supply chain in fusion market segment. **Target Groups**: fusion plants. **Further investment to reach higher TRL (> 6)**: follow-on grant towards IA (TRL 7). **Target TRL:** Short-term: TRL 6 (2028). Long-term: TRL 7 (2030)
Partner: CORNAGLIA (end-user & technology provider)
Exploitation assets: new laser welding capability for improved quality and flexibility applied to battery cooling for automotive e-mobility.
Type of Exploitation: COMM with possibility for licensing/patenting the developed methods and systems for assembling the battery cooling in a cost-effective manner. **Approach to reach higher TRL (> 6)**: (1) Directly enter in the market of battery cooling plates for e-vehicles and run pilot campaigns with consolidated customers. (2) To establish new business opportunities - participation to most important fairs of the automotive sector, and illustrate the results of the innovative laser welding solution through the exposition of produced section improving its public reputation. **Further investment to reach higher TRL (> 6)**: follow-on grant towards IA (TRL 7); private investment by company to reach TRL9 and above (MRL). **Target Groups**: automotive OEMs/end-users. **Target TRL:** Short-term: TRL 6. Long-term: TRL 9 (2030).
Partner: FFT (technology provider)
Exploitation assets: (1) system integration and machine configuration using dynamic laser beam shaping; (2) development of new modular and flexible fixtures as well as jig-less manufacturing concepts for laser welding of battery cooling systems; (3) development of a production plant framework for capturing and exchanging data of product, process and plant efficiently.
Type of Exploitation: COMM via increased service offer. Direct B2C sales, penetrating end-users. **Approach to reach higher TRL (> 6)**: (1) Marketing and commercial campaign focused on strategic potential new customers, and run pilot campaigns with consolidated customers. (2) Expansion of service portfolio for OEMs/end-users to increase revenue, including: (a) robot-guided laser welding technologies for battery cooling systems; (b) smart, intelligent plant systems by modules for in-line process monitoring, control and predictive maintenance; (c) robustness/availability of laser welding processes due to an improved degree of automation; (d) faster and easier reconfiguration and reuse of plant systems for production and batch changes. **Further investment to reach higher TRL (> 6)**: private investment by company to reach TRL9 and above (MRL). **Target Groups**: OEMs/end-users. **Target TRL:** Short-term: TRL 6 (2028). Long-term: TRL 9 (2030).
Partner: FUTURICE (technology provider)
Exploitation assets: (1) digital platform for smart, decentralised and sustainable manufacturing; (2) framework for fast, secure and trusted data sharing across company boundary.
Type of Exploitation: COMM via direct license purchase. **Approach to reach higher TRL (> 6)**: (1) Marketing and commercial campaign focused on strategic potential new customers, and run pilot campaigns with consolidated customers to foster user acceptance. (2) Matching value chain by offering competitive new digital platform, leading to increased tech consulting and implementation revenue based on implementation engagement with the new partners of the platform and/or clients of the platform. **Further investment to reach higher TRL (> 6)**: follow-on grant towards IA (TRL 7); private investment by company to reach TRL9 and above (MRL). **Target Groups**: OEMs/end-users, machinery & manufacturing. **Target TRL:** Short-term: TRL 6 (2028). Long-term: TRL 9 (2030).
Partner: ECOR/CAMPUS (end-user & technology provider)
Exploitation assets: (1) new laser welding capability for improved quality and flexibility; (2) digital platform for real-time decision making, certification and quality assurance.
Type of Exploitation: COMM via increased service offer with increment of the actual production capability and the acquisition of new core manufacturing technologies. **Approach to reach TRL7 (new process digital technologies consolidation: 6-8 months after closure of Lasers4MaaS)**: (1) Matching value chain by reducing process development time. (2) Enhancing process robustness via the adoption of the new laser welding assets and digitalised technologies aiming to improve the weld seam and products quality. **Approach to reach TRL8 (application of new process digital technologies to products: first 6-8 months of 2029):** (1) Implement a validation plan of components already produced by TIG, LASER, EBM welding in the Food, Aerospace, Energy sectors among the actual production.

(2) Ensure product robustness by the evidence of technical documentation, involving the customer (R&D, Quality, Production) in the process set-up phases, process/product qualification and final validation. Once the customer has direct evidence of process/product robustness the acceptance of the new digital LBS technology concept is strongly favored. (3) Explore industrial tests in the dedicated industrial environment (4) Further certify the dynamic beam shaping technology and related production methods with the support from certification companies (e.g., Rina Consulting for Functional Product Safety, Environmental Product Declaration (EDP)). **Approach to reach TRL9 (consolidating and expanding actual product and new markets: last 6-8 months in 2029):** (1) Market diversification - the competitive advantage of installing the most suitable advanced laser welding technologies developed in the project, will reinforce the leading position of ECOR contributing to more affordable business propositions towards diversification of market sectors (aerospace, energy, pharma). (2) Selection of new customers on the EU Market - actions will be implemented by attending market fairies and contacting companies in the field. This strategy has been already successfully adopted for the Life Science (Agilent), Pharma sector (IMA), Packaging (Philips Morris). ECOR has already Multidisciplinary company teams for investigating new market and positioning (i.e. pipes for Hydrogen and Pharma, Defence). The synergy with commercial strategies more focused on sectors where the technologies and competences can be better exploited, has been demonstrated to be suitable for increasing revenues in new markets and/or new customers. (3) Ensure continued participation at the most relevant market events for the Food processing & packaging industry, Pharma, Aerospace, Defence, Energy. **Further investment to reach higher TRL (> 6): Target Groups**: OEMs/end-users in aerospace, energy, pharma (IMA), packaging (TETRAPAK is already part of the industry advisory board). **Target TRL:** Short-term: TRL 6. Long-term: TRL 9 (2030-2031).

4. Risks, non-economic viability and liability

Non-economic viability and liability refer to factors that can affect the success and sustainability of a project or technology beyond purely financial considerations. Non-economic viability includes aspects such as technical feasibility, safety, environmental impact, and societal acceptance. Any new technology which introduces new complexities or requires specialized expertise that is difficult to obtain, its technical viability could be questioned. Similarly, concerns related to the technology's environmental footprint, its compatibility with existing infrastructure, or its compliance with industry regulations could pose challenges. Liability, on the other hand, refers to legal responsibilities that arise from the deployment and use of the technology. This may involve product safety issues, intellectual property disputes, or potential damages caused by faulty equipment. Ensuring non-economic viability and managing liability risks are critical for ensuring that a project is not only economically profitable but also safe, sustainable, and legally compliant in the long term. The Consortium has already identified the barriers that might hinder the impact, and set the mitigation measures to avoid these barriers to jeopardise the project's wider exploitation. These are listed in Table 4.

Table 4: Barriers to market and mitigations

Factor	Requirements for impact achievement	Potential barriers for impact achievement	Mitigation measures to limit the impact of potential barriers
Economical	The price of the solution must be affordable to motivate a rapid adoption of the platform.	A solution too expensive to be implemented and benefits too difficult to be calculated.	All project results will be available on a single digital platform to facilitate the access to the project's solutions; and, some of the results will be disseminated and made available on a free-of-charge approach (for example, the "Welding Process Analytics Database").

Social	The project needs to take the human needs and capacities into account.	No sufficient skilled workforce to implement the project's propositions and results.	Training activities will be set-up for apprentices, professionals and students, to prepare them to the use the project services.
Technological	New potential competing solutions in the market permeating faster.	Solutions from other research projects or industrial R&D programmes may emerge during the project providing alternatives to LasersMaaS project outcomes.	LasersMaaS can gain a competitive advantage in relation to alternatives: (1) adopting a pricing strategy convenient for its direct end-users (project partners); (2) stressing its unique value proposition via outreach and dissemination; (3) securing industrial support for further research and understand the needs of the industry (the Industry Advisory Board will play a key role towards this risk mitigation).
Standards	Developing standards in line with the project for a competitive advantage.	The development of standards is a long process with no guarantees.	Lasers4MaaS will present standard suggestions for data interoperability, digital product passport.

Taking in account its nature and the technologies involved, we have identified some specific liability factors that can affect its success and compliance. These include:

- **Safety and Health Risks**: laser technologies, particularly high-powered lasers used in manufacturing, can pose significant health and safety risks. Improper use or lack of adequate safety measures may result in accidents, injuries, or damage to property, leading to legal liabilities, insurance claims, and regulatory penalties. Compliance with safety standards such as the EU Machinery Directive and Laser Safety Regulations is crucial.
- **Product and Software Liability**: Lasers4MaaS will involve a complex software system for automation, predictive maintenance, and real-time monitoring. If the software malfunctions, causes production delays, or leads to faulty products, it could lead to product liability claims. Manufacturers could be held responsible for damages resulting from software errors or malfunctioning platforms that disrupt operations.
- **Security and Cyber Risks**: digital platforms for manufacturing are often connected to networks, creating vulnerabilities to cyber threats. A breach in cybersecurity or failure to protect the platform from cyberattacks (e.g., ransomware or data breaches) could lead to financial losses, disruptions in production, and significant legal liabilities. Compliance with EU cybersecurity regulations such as the NIS Directive is essential to avoid such risks.
- **Intellectual Property (IP) Issues**: collaborative technology projects may involve the creation of new patents, designs, or software. In particular, digital platforms typically integrate advanced software, algorithms, and proprietary systems that could involve IP ownership issues. Disputes over patents, licensing, IP ownership, and usage rights can arise, particularly in cross-border collaborations. Failure to clearly define IP rights in consortium agreements may lead to legal claims, financial liabilities, or restrictions on the commercialization of project outcomes.
- **Environmental Compliance**: projects that involve manufacturing or industrial applications of lasers must comply with EU environmental regulations, such as the Waste Electrical and Electronic Equipment (WEEE) Directive and Restriction of Hazardous Substances (RoHS). If laser-based products or processes generate hazardous waste, emissions, or pollution, failure to meet these environmental standards could result in fines or environmental liabilities.
- **Data Protection and Privacy Concerns**: digital platforms in manufacturing often involve the collection, processing, and storage of large amounts of sensitive data. Non-compliance with GDPR (General Data Protection Regulation) can lead to significant fines and legal consequences, especially if personal data is mishandled or exposed through breaches. Additionally, data security issues, such as

cyberattacks or hacking attempts, could lead to financial liabilities and reputational damage.

- **Delays in Development or Failure to Meet Milestones**: if a project experiences delays or fails to meet technical milestones (due to technological challenges, supply chain issues, or other factors), it may lead to financial penalties, loss of funding, or legal disputes. Meeting performance targets and deadlines is critical to maintaining project viability and compliance with EU regulations.
- **Contractual Obligations**: misunderstandings or breaches of contractual terms between project partners, or between the project consortium and the EU, may lead to disputes, financial losses, or legal action. Ensuring clarity in agreements regarding responsibilities, deadlines, and deliverables is critical.
- **Third-Party Claims**: if a project causes damage or harm to third parties—whether through accidents, the use of defective products, or failures in safety—claims for compensation can arise, potentially leading to financial and legal liabilities.

A detailed risk analysis is developed in WP20-22 and presented in D20.2 (project and risk management plans).

5. Additional measures to maximise exploitation

The project will also be supported by an industrial Advisory Board (AB), as listed in Table 5.

Table 5: Selected members of the Advisory Board

Role	Member
Maximise dissemination and exploitation	• ARENA2036 – https://arena2036.de/en/ • AILU - https://www.ailu.org.uk/
Potential end-user and/or buyer	• BLS Lasertechnology - https://www.bls-lasertechnology.de/?lang=en • TETRAPAK - https://www.tetrapak.com/en-gb • ADMEDES - https://www.admedes.com/en • Carrs welding - https://carrswelding.co.uk/ • Kesseböhmer Holding KG - www.kesseboehmer.com/en • IMA Group - https://ima.it/en/
General advisor	• Till Issler, responsible for the digital ecosystem PRO360 (www.bosch-professional.com/pro360/) and the PRO Service (www.bosch-professional.com/pro360/proservice/) • PRé - https://pre-sustainability.com/

A dedicated budget has been allocated via WMG to allow the effective participation of the Advisory Board participants in some of the project's meetings (details in 5). The industry advisory board will support and streamline the dissemination, ensuring the project's findings reach and impact a wide range of industrial sectors; but also strengthen the exploitation roots. An NDA is being developed to formalise the engagement with the Advisory Board.

Table 6: Planned meetings with engagement of the Advisory Board

Type	When	Who	Mode
GA and kick-off	Month 2	Lasers4MaaS consortium and EU officer	Face-to-face
GA meeting	Month 6	Day#1: Lasers4MaaS consortium Day#2: Lasers4MaaS consortium	Face-to-face (option for on-line attendance if strictly required)
GA, year#1 review with EC and AB meeting	Month 12	Day#1: Lasers4MaaS consortium Day#2: Lasers4MaaS consortium and AB Day#3: Lasers4MaaS consortium, EU officer, EU reviewers	Face-to-face (option for on-line attendance if strictly required)

GA and regular review with EC	Month 18	Day#1: Lasers4MaaS consortium Day#2: Lasers4MaaS consortium members Day#3: Lasers4MaaS consortium, EU officer, EU reviewers	Face-to-face (option for on-line attendance if strictly required)
GA and AB meeting	Month 24	Day#1: Lasers4MaaS consortium - current status and AB meeting Day#2: Lasers4MaaS consortium – planning ahead	Face-to-face (option for on-line attendance if strictly required)
GA and AB meeting	Month 30	Day#1: Lasers4MaaS consortium Day#2: Lasers4MaaS consortium, AB members	Face-to-face (option for on-line attendance if strictly required)
GA and regular review with EC	Month 36	Day#1: Lasers4MaaS consortium - current status Day#2: Lasers4MaaS consortium – planning ahead Day#3: Lasers4MaaS consortium, EU officer, EU reviewers	Face-to-face (option for on-line attendance if strictly required)
GA and regular review with EC	Month 42	Day#1: Lasers4MaaS consortium Day#2: Lasers4MaaS consortium, AB members Day#3: Lasers4MaaS consortium, EU officer, EU reviewers	Face-to-face