

FLASH

Flexible Laser-Based Manufacturing

D9.5 – First Interim Plan for Exploitation Framework

HORIZON-CL4-2023-TWIN-TRANSITION-01-02.



Co-funded by
the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Health and Digital Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.



FLASH

Flexible Laser-Based Manufacturing

Revision	Date	Author/Organisation	Description
1 st	15.05.2024	Fátima Zorro / EWF	Initial Complete Draft
2 nd	24.05.2024	Fátima Zorro, Rita Bola /EWF	Updated Complete Draft
3 rd	13.06.2024	All partners	Updated Complete Draft
4 th	19.06.2024	Fátima Zorro, Rita Bola /EWF	Final version addressing consortium partners' comments



INDEX OF THE DOCUMENT

General Information.....	5
Executive Summary	6
Introduction.....	7
FLASH Project.....	7
Plan for exploitation framework	7
Exploitation Strategy	8
FLASH system exploitation plan	8
FLASH Sub-systems Exploitation Plans.....	8
Review from Market.....	9
Description of the market.....	9
Automotive and e-mobility	10
Medical Devices.....	10
Tooling.....	11
Conclusion	11
Competitors and Competing solutions	12
Technology description.....	12
FLASH Main exploitable results and associated TRLs.....	13
Benefits of the Technology	14
Specific end-users' benefits	15
FLASH KPIs.....	15
Value Chain and Routes to Market	18
Overall system	18
Sales Forecast	19
Individual partners assessment	20
Costumer Segments.....	26
Background IP identified by partners.	27
Ownership vs. Authorship of project results	27
Standard Operating procedure for Exploitation.....	28
Classification of exploitation interests.....	28
Identification of active contributions and ownership models.....	29
IP protection measures	30
Innovation management.....	30
Conclusion.....	31
Annex I – Exploitation Strategy Form.....	32



LIST OF FIGURES

Figure 1 – Evolution of laser processing market size from 2022 to 2032.....	9
Figure 2 – Laser processing market share by application (in 2022).....	10
Figure 3 – Infographic on the medical laser systems market region, specific applications, and possible evolution between 2019 and 2030 ^[5]	11
Figure 4 – FLASH Value Chain.....	18
Figure 5 - Ownership vs. Authorship of project results.	27

LIST OF TABLES

Table 1 - FLASH Exploitable Results.....	13
Table 2 - TRL Descriptors.....	14
Table 3 – FLASH KPIs.....	16
Table 4 – PRIMA FLASH-IANUS Sales forecast	19
Table 5 – FLASH commercial offering and expected values.....	20
Table 6 – Target Industries and potential customers by sector.....	26
Table 7 – Partners’ background IP	27

ABBREVIATIONS

AI - Artificial Intelligence
BI - Business Intelligence
CAPEX – Capital Expenditure
CMC - Ceramic matrix composite
CNC - Computer Numerical Control
IP - Intellectual Property
KER - Key Exploitable Result
LCA - Life Cycle Assessment
LCI - Life Cycle Inventory
LCIA - Life Cycle Impact Assessment
LCS - Laser Cutting Systems
LMJ-iP - Laser MicroJet Integration Package
LPBF - Laser Power Bed Fusion
ML - Machine Learning
QCW - Quasi Continuous Wave
SOP - Standard Operating Procedure
TRL - Technology Readiness Level
UC – Use case



Co-funded by
the European Union

WJG - Waterjet Guided



General Information

Project	
Title	FLASH
Acronym	Flexible Laser-based manufacturing through precision photon distribution
G.A. number	101138380
Topic	HORIZON-CL4-2023-TWIN-TRANSITION-01-02
Website address	http://FLASHLaserProject.eu/
Start Date	1 st January 2024

Deliverable	
Deliverable name	First Interim Plan for Exploitation Framework
Deliverable number	9.5
Work package	WP9 – Exploitation, dissemination, training and standardisation RP1
Dissemination level	PU – Public
Date of delivery	30-06-2024
Keywords	Exploitation, market, IPR
Status	Final

Author	
Authoring partner	European Federation for Welding, Joining and Cutting
Contact person	Fátima Zorro
Email Phone	fzorro@ewf.be 910352202



Executive Summary

This deliverable provides the first version of the Exploitation Plan for the FLASH project results. It includes a first assessment of the preliminary key exploitable results, and the ways and modes the consortium plans for the creation of impact and its legacy. The current exploitation process covers market analysis with its segmentation and significant value proposition, defining IP strategies and refining appropriate business models.

The Exploitation Plan will be regularly reviewed and updated as needed throughout the project to ensure dynamic and successful exploitation of project results, to ensure protection and avoid infringement of Intellectual Property Rights, and to mitigate risks that could endanger the exploitation of the results. At the end of the project, this deliverable will be integrated into the Final business & exploitation plan, including the plan for dissemination, exploitation and communication report.



Introduction

FLASH Project

The FLASH initiative aims to revolutionize manufacturing by harnessing the advantages of laser technology to achieve flexible and customizable production. Traditional manufacturing tools were designed for stability and uniformity, but with shorter product lifecycles and increasing demand for mass customization, the need for flexibility is paramount. Laser-based processes offer greater flexibility, efficiency, and precision compared to traditional methods.

However, current laser-based technologies still face limitations, such as existing machines being tailored for specific applications, traditional processes struggling with advanced materials like composites and highly reflective materials, there's a lack of expertise, making process design slow and costly.

To address these challenges, FLASH proposes advancements in laser machining technologies, focusing on:

1. Integrating multiple laser sources and beam delivery heads into a single module.
2. Implementing dynamic beam shaping.
3. Developing in-process monitoring and control systems.
4. Enhancing process design for laser-based manufacturing.

The FLASH platform will feature a hybrid robotic/CNC setup with advanced digital infrastructure for process design, monitoring, and control. It aims to create a future-proof system capable of performing a wide range of production processes on various materials, enabling the flexible manufacturing of complex products such as orthopaedic implants, micro tools, automotive components, and more.

Plan for exploitation framework

In a project such as FLASH, bringing the technology from an R&D level to commercialization represents the main goal for the consortium partners. The advantages of the technology being developed are of added value and will have a high impact on the value chain of different products from different industries. Thus, the project's developments must take the right steps towards the expected outcomes. The present document will enable the consortium partners to be placed in the value chain of the FLASH system and ensure that they're aligned regarding the steps towards commercialization of the full laser system and other subsystems that are prone to be exploited as standalone products and/or services.

This plan also includes an intellectual property (IP) management strategy, since IP management and Exploitation aims at facilitating a transparent process, clarification of (co-)ownership of results, identifying whether the results are capable of industrial or commercial application or can be readily disseminated as scientific results, preparing IP documentation for evaluation by the Executive Board.

For this purpose, EWF in collaboration with the consortium partners, is committed to developing an Exploitation Plan for the project's results. The First Interim Plan for Exploitation Framework (D9.5) is delivered in month 6 of the FLASH project and the Final version (D10.3 – Final business & exploitation plan, including PDEC report) is expected in month 36.



Exploitation Strategy

The exploitation strategy for the FLASH project will focus on two main outcomes:

1. FLASH overall completed system, and
2. FLASH sub-systems.

Due to the nature of the FLASH project, mainly related to the different technologies involved, the developments and results of the individual technologies that are required to have a fully completed FLASH system, may also be channelled to other types of systems that may be used in different applications and/or fields.

Despite the focus of the exploitation activities to be around the FLASH final system, assessing other exploitation routes for the different sub-systems developed during the project presents a great opportunity to widen the range of possible commercialization routes to their products and/or services.

FLASH system exploitation Plan

The FLASH system is the result of different technologies developed by different partners integrated into one system. To have an impactful exploitation plan all partners must be aligned and aware of their role and involvement in the value chain of the outcome.

The assessment made will allow the alignment of the role of individual partner expectations in the overall project's exploitation plan. The identification of the individual partner's expectations through technical and nontechnical KPIs will also serve as guidelines for the development work being made.

The first exploitation step to be taken with the partners will be around the technology and identifying the right approach to the engagement between them. This will be the basis for the final exploitation plan that will be further developed and matured in the second stage of the project, as the expected results are achieved. The second interaction, in a later phase of the project, will be around the validation of the technology against the project demonstrators, as well as assessing the final numbers for the business cases of the end-users.

A comparison of the FLASH technology with other related available technologies will set the basis of the exploitation plan and will allow the consortium to better position itself in the commercialization of the FLASH system.

The exploitation will be driven by the project results and aligned in parallel assuring that all actions lead to the highest impact and fast implementation of the commercialization roadmap.

FLASH Sub-systems Exploitation Plans

The nature of the project, with multiple developments happening simultaneously, will lead to different technologies being integrated into the FLASH system. Moreover, other exploitable results will also arise from the work being developed. Even though the results fall under the scope of the project, the opportunity to explore individually each result also represents a viable approach to widen the commercialization of the project results after its end. Thus, partners need to identify and assess how the work being developed could be integrated into their offer to clients while assuring that the commitment to the FLASH system is maintained.

To ensure the alignment between the partners, all plans to exploit the sub-systems that will be integrated into the FLASH system and may be explored individually will be reported as an integrated part of the FLASH overall exploitation plan. Partnerships

between the consortium partners to explore some of the results will also be assessed and if possible, will provide a great opportunity to widen the cooperation between multiple entities making them more competitive and capable of addressing the market requirements.

Review from Market

The FLASH project aims to mainstream laser machining processes such as cutting, welding, drilling, milling, texturing, and polishing at the industrial level. Thus, it is important to do a potential assessment of markets in which the consortium expects its implementation. Moreover, despite the assessment being made at the end-user industries (automotive, e-mobility, medical devices, and advanced tooling) the technology is prone to be used in other industries due to the framework of the FLASH system that is expected to enable the processing of different parts with different materials and shapes. During the second period, further assessment will be made to identify other possible applications of the technology being developed.

FLASH is developing a world-leading flexible laser-based manufacturing technology for the processing of a wide range of materials and products. It is a project that is transforming our current technologies possessing clear advantages over the traditional existing solutions: mechanical, chemical, or thermal processes. In the following subchapters, a market review will be performed, as well as an assessment of current technology competitors and competing solutions.

Description of the market

The global laser processing market size was estimated at USD 20.64 billion in 2022 and is expected to hit around USD 44.09 billion by 2032, growing at a compound annual growth rate of 7.89% from 2023 to 2032^[1], as shown in Figure 1.

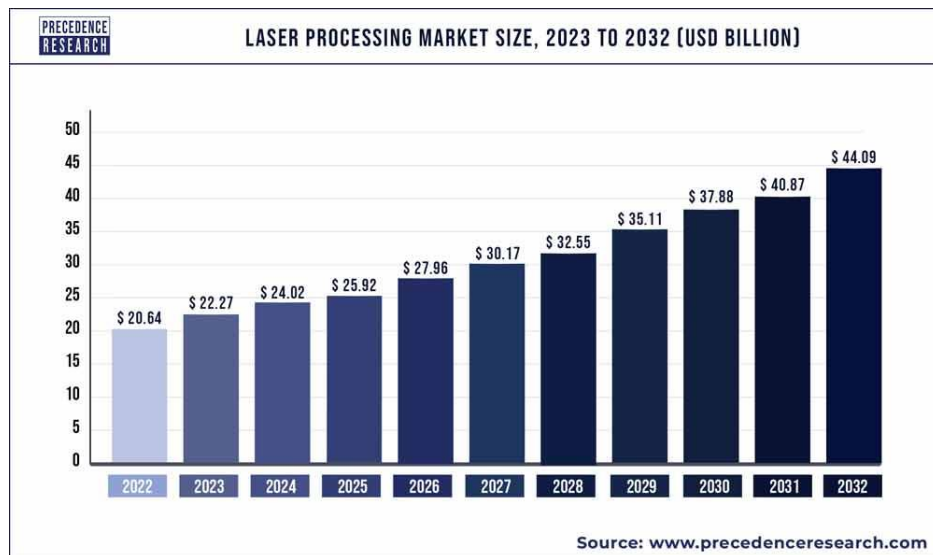


Figure 1 – Evolution of laser processing market size from 2022 to 2032.

The underpinning growth driver will be the trend towards improving productivity, efficiency, and accuracy, all of which are addressed by FLASH. This is alongside the growth in demand for systems and processes offering better material processing capabilities, especially in industries such as aerospace and automotive where the innovation in materials is accelerated to find performance gains^[2].

The versatility of the FLASH platform opens the market potential to a wide range of industries and potential customers. Nanosecond lasers are useful for applications that

require high precision, such as in the electronics industry where the laser can produce fine and detailed components with minimal damage. Quasi Continuous Wave (QCW) lasers, on the other hand, are better suited for applications that require high power and continuous operation, such as in the aerospace industry where the laser can be used for cutting, drilling, and welding of high-strength materials.

Based on the application, the laser processing market is segmented into automotive, aerospace, machine tools, electronics and microelectronics, medical, and packaging. In 2022, the machine tools segment led the industry with a revenue share of more than 31%^[1], as shown in Figure 2.

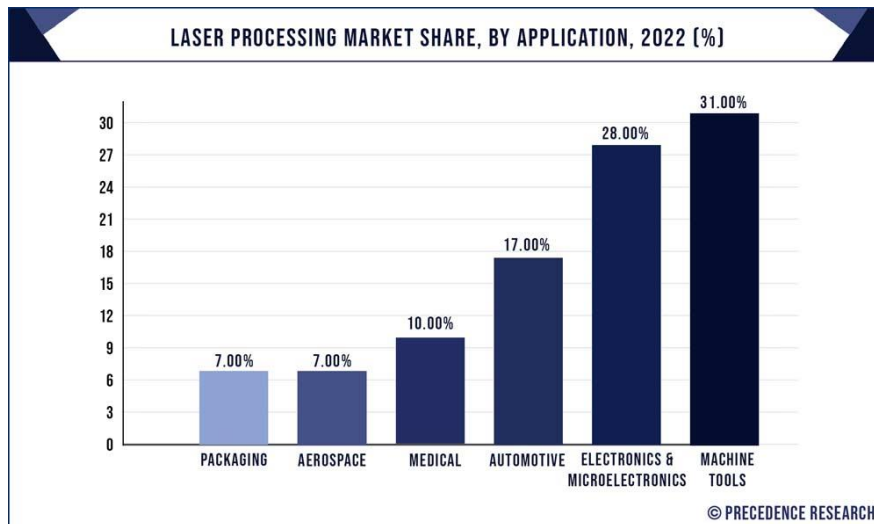


Figure 2 – Laser processing market share by application (in 2022).

Automotive and e-mobility

The automotive industry is one of the largest application areas for laser material processing. McKinsey's Future Mobility Center has already reminded that the automotive industry is "the growth engine of the European economy", accounting for approximately 7% of the EU's GDP^[3]. Growth in the European automotive industry is on the rise. For example, in the first nine months of 2022, nearly 8 million passenger cars were produced in the EU. Compared with the same period in 2021, the number of units increased by 5.8%^[4]. Lasers play a crucial role in optimizing automobile manufacturing due to their versatility, precision, and speed. They are used extensively for various processes including cutting, welding, marking, and additive manufacturing, making them indispensable tools in high-volume automotive production lines. Lasers can handle a wide range of automotive components made from different materials, enhancing efficiency and quality in manufacturing processes.

In the scope of the FLASH project, laser welding, cleaning, marking, and cutting for components and assemblies will be used in the automotive industry. The objective is to reduce component weight, improve the quality, strength, and durability, as well as reduce assembly time and costs.

Medical Devices

The urgent demand for cost-effective medical devices and surgical tools, coupled with aging populations in many countries, has driven significant innovation in manufacturing. This innovation is particularly evident with the adoption of laser cutting, welding, drilling, and marking for medical applications. The advanced capabilities of laser machining largely facilitate the preference for smaller, lighter, and

more intricate medical devices and surgical tools by doctors and patients, as shown in Figure 3.



Figure 3 – Infographic on the medical processing systems market ^[5].

In the scope of the FLASH project, laser cutting, welding, marking, and drilling for surgical tools implants, and devices will be used in the medical devices industry. The objective is to produce precise components that are critical for medical device applications, as well as enable the production of complex and customized devices.

Tooling

To produce complex and high-precision components, ideal for aerospace applications where accuracy and weight reduction are critical, with minimal material waste, laser cutting, drilling, machining, and welding may be used. Also, to produce high-precision and high-density electronic components with minimal damage or distortion, for electronics applications, in this case, due to the accuracy and reliability, which are critical, laser cutting, drilling, marking, and welding will be employed.

The global Laser Drilling Machine for aerospace market was valued at US\$ 133.4 million in 2020 and it is expected to reach US\$ 182.8 million by the end of 2027, growing at a compound annual growth rate of 4.6% during 2021-2027^[6]. In the scope of the FLASH project, laser systems will be used to produce tools for aerospace and electronics applications.

Conclusion

As observed, the markets where FLASH technology can be addressed, and their shares, are significant. The technology has the potential to create high-precision, detailed components with minimal damage and waste, hence, possessing advantages that can cover various market sectors. The ones identified above are focused on the market sectors of the project end-users which are thriving ones. In future iterations, there will be developed an analysis on sectors not directly foreseen for FLASH to evaluate the exploitation potential and benchmark in other markets.

References

- [1] <https://www.precedenceresearch.com/laser-processing-market>
- [2] Industrial Laser Systems Market Analysis, Coherent Market Insights, March 2023.
- [3] McKinsey Center for Future Mobility: Race 2050 – A Vision for the European Automotive Industry
- [4] <https://www.acea.auto/fact/facts-about-the-automobile-industry/>
- [5] Laser Processing Equipment Market Size: 2024 – 2032, Market Insights, March 2024
- [6] Laser Drilling Machine for Aerospace Market
(https://www.businessgrowthreports.com/enquiry/request-sample/19852389?utm_source=Poojalinkedin)



Competitors and Competing solutions

Since new innovative equipment is being developed, its competitors/competing technologies were also analysed to understand the advantages and disadvantages of each one of them when compared to FLASH. This allows for the proper identification of the FLASH potential market as well as other possible end-users for the technology, in more detail. This detailed analysis can be seen in the D9.3 – Interim Report on Future Tech Analysis, which concluded that only Trumpf and DISCO were identified as making patent applications that were considered directly relevant to the Key Exploitable Results (KERs) and Use Cases (UCs) of the FLASH project.

Technology description

The FLASH technology seeks to enhance manufacturing processes through advanced features such as agility, speed, cost-efficiency, material versatility, energy savings, and precision. It will enable a swift reconfiguration of manufacturing processes, achieving automated changeover of the beam delivery system in 10-15 seconds, a remarkable improvement over traditional methods that require minutes to hours. Furthermore, FLASH will reduce cycle time by up to 50% compared to conventional multi-process manufacturing flows.

Therefore, technology development and integration plan for FLASH encompasses several key components aimed at enhancing manufacturing processes:

Firstly, the focus is on developing and validating a versatile **beam source and delivery module**. This involves combining a 1070 nm Quasi Continuous Wave (QCW) CW-0.1 ms laser with 532 nm lasers spanning from 0.1 to 100 nanoseconds using a fiber coupling unit. Additionally, a fiber switch will be implemented to accommodate three interchangeable beam delivery heads. These heads include a nozzle-based system for high-power thermal applications, a Water Jet Guided (WJG) system for precision cutting and drilling of advanced ceramics and composites, and a galvo scanner-based system for micro-machining and surface engineering tasks. Notably, the technology will allow for automated changeover of beam delivery heads within a rapid 10-15-second timeframe.

Secondly, **dynamic beam shaping (XY) and focus control (Z)** will be developed and integrated to ensure precise photon distribution. This includes achieving over 90% homogeneity in photon distribution, more than 99% transmission, and a depth of field exceeding 8 mm. The system will also enable XY adaptive energy distribution for shape adjustments within a swift 10 milliseconds and rapid focus steering in the Z-direction of up to 20 mm in under 2 milliseconds.

Thirdly, a universal **in-process monitoring and control** solution will be devised, leveraging acoustic and optical sensors. This solution is designed to maintain stable manufacturing processes suitable for unsupervised 24/7 operation in industrial environments. It is anticipated to deliver direct productivity increases of at least 10% and manufacturing yields of 99.3%.

Furthermore, **process design and life-cycle assessment** models will be integrated using machine learning, multiscale physics simulation, and an experimental database. This integration aims to minimize waste, defects, process costs, and energy consumption, thereby reducing the time and cost associated with process development for new product development by at least 50%.

Finally, all technology modules will be integrated into a **machine demonstrator** featuring a flexible 6-axis robot and 4-axis CNC-controlled XY (B/C, and rotary/tilt



stage). This demonstrator will provide a working envelope of (L) 1600 mm x (W) 1200 mm x (H) 700 mm with positional accuracy of less than 10 µm and repeatability of less than 5 µm, making it ready for operational demonstration.

FLASH Main exploitable results and associated TRLs

A preliminary assessment of the Technology Readiness Level (TRL) was made by the consortium based on the expected project results. The initial TRL of the results was determined as well as the final expected TRL, which are listed in Table 1. The FLASH innovation draws upon various validated technologies, either through early adopter validation or partner validation studies on pertinent test components (TRL5). Collaborating partners will work together to advance and amalgamate their respective technologies into an integrated laser machine demonstrator. This machine will undergo operational testing in real manufacturing trials of practical components, elevating its readiness level to TRL7. Subsequently, end users will conduct comprehensive industry-standard performance evaluations on the demonstrated machine.

Table 1 - FLASH Exploitable Results

Project Main results			
	Results	Initial TRL	Expected TRL
Integration of three laser sources and three beam delivery heads	Robotic platform for laser processing machine [PRIMA]	5	7
	Streamlined integration of a Laser Micro-Jet system in to a robotics platform [SYN]	5	7
	Dual Green combined (short pulse and long pulse) laser beam through the Water jet guided laser, for more reliable thicker (1-20mm) cutting, and cut surface quality [SYN]	4	7
	Fibre switching integration [CAI]	5	7
Dynamic beam shaping and focus control [CAI, ROB]		5	7
In-process monitoring and control	Adaptation and mounting optical sensor in a common position in the beam path [SYN]	5	7
	Simplified process monitoring learning on multi-sensor system using AI	4	7
	Acoustic & optical sensor fusion array to enable process verification and validation [AIMEN]	5	7
FLASH System		5	7
Other Results			
Know how gathered during FLASH (possible consultation services, other research projects ...)	Technology transfer plan for uptake of processes by end-users	NA	NA
	FLASH work-based learning and training resources		
Testing methodologies deriving from FLASH [SYN, AIMEN]		5	7
Models and metrology solutions to a database of parameters and outcomes. [COS, HUD, MTC]		5	7
LCA data integration in decision making tools for the FLASH system and outcomes [3DR]		5	7
Knowledge and Software Deployment Processes [ATS]		5	7



Business case for the Synova Fiber Coupling Module (modified for Flash) as a standalone offering for laser processes other than the Laser Micro-Jet [SYN]	3	7
End users' Applications		
Laser-based process for manufacturing orthopaedic hip implant system [DPS]	5	7
Laser-based process for manufacturing PCD micro drills [DIA]	5	7
Laser-based process for manufacturing CBN grinding wheels [DIA]	5	7
Laser-based process for manufacturing lightweight steel and aluminium CCB [TOFAS]	5	7
Laser-based process for copper hairpin stripping and welding [ATOP]	5	7

The TRL assessment was made based on the definition of the European Commission on HORIZON EUROPE – WORK PROGRAMME 2023-2025 and is listed in Table 2:

Table 2 - TRL Descriptors

Level Description	
TRL 1	Basic principles observed
TRL 2	Technology concept formulated
TRL 3	Experimental proof of concept
TRL 4	Technology validated in a lab
TRL 5	Technology validated in a relevant environment (industrially relevant environment in the case of key enabling technologies)
TRL 6	Technology demonstrated in a relevant environment (industrially relevant environment in the case of key enabling technologies)
TRL 7	System prototype demonstration in an operational environment
TRL 8	System complete and qualified
TRL 9	Actual system proven in an operational environment (competitive manufacturing in the case of key enabling technologies, or in space)

Benefits of the Technology

The FLASH technology offers several significant benefits to the manufacturing industry:

- **Agility:** The ability to reconfigure manufacturing processes rapidly during product development by automating the changeover of the beam delivery system in just 10-15 seconds, compared to the much longer time required for traditional mechanical or laser machines. This agility allows for quick adaptation to changing materials and applications through precise control of laser parameters.
- **Speed:** FLASH can reduce cycle time by up to 50% for previously multi-process manufacturing flows. This means significant time savings, such as reducing total machining time from 8-10 minutes to 4-5 minutes, including nozzle changeover for specific applications like hip implant systems.



- **Low Capital Expenditure (CAPEX) and space requirements:** Implementation of FLASH can lead to substantial capital investment savings of at least €700k (~40-60%) compared to acquiring separate laser tools needed for various machining tasks. Additionally, FLASH occupies a much smaller physical footprint, approximately 86% less than the combined footprint of multiple separate machines currently used for similar tasks.
- **Material flexibility:** FLASH enables high-quality, defect-free machining of advanced and highly reflective metals, as well as innovative materials like ceramic matrix composites (CMCs) and metal matrix composites. This flexibility allows manufacturers to adapt to future material trends and advancements seamlessly.
- **Energy savings:** FLASH offers significant energy savings, with potential reductions of up to 78% compared to traditional single-step laser processing methods and 66% compared to running three separate laser machine tools with associated equipment such as chillers and extractors.

Overall, the benefits of the FLASH project include increased agility, speed, cost-effectiveness, material flexibility, and energy efficiency, ultimately leading to enhanced competitiveness and responsiveness to new opportunities in the manufacturing industry. Note that all these capabilities, characteristics, and advantages will be validated and assessed against real case scenarios during the second project period, upon the commissioning of the system.

Specific end-users benefits

Based on the work developed, the end-users have identified the benefits that the implementation of the technology will bring to their value chain. Summarizing, the benefits for the different end-users are:

DPS - Orthopaedic hip implant system: 4-5 minutes saved per acetabular cup enabling potential tripling of throughput. Costs saving through eliminating polishing media, titanium swarf avoided, 10% scrap rate eliminated.

DIA - PCD micro drills: Eliminate tool breakages on small-diameter tools. Faster throughput to produce more drills with customizable structures enabled with FLASH. FLASH enables better-performing surfaces with superior chip deflection and cooling with microfeatures.

DIA - CBN grinding wheels: Galvanic electroplating eliminated saving the 2 days – 6 weeks cycle time and all chemicals and costs. Improved capacity along with a highly customisable laser-processing base.

TOFAS - Steel and aluminium CCB: Reduce steel to aluminium ratio, reduce weight by ~1.5 kg/CCB. Reduce welding time to ~300s from 900s, currently achieved with gas metal arc welding, leading to increased throughput. Annual energy savings 108MWh/a based on annual production/ 46.6 tonneCO_{2eq}.

ATOP - Copper hairpin stripping and welding: Defect-free fast laser stripping (12cm²/s) with dual-laser processing enabling a throughput. increase. High-precision welds completed by hybrid dual-beam laser welding to eliminate poor quality welds and defective e-motor production.

FLASH KPIs

Internally, partners have established Key Performance Indicators (KPIs) as a set of goals to be validated against the outcomes of the project. These indicators will serve as a guideline for the work being carried out and assure that the technical



developments are aligned with the expected targets of the consortium partners. These KPIs per partner are listed in Table 3.

Table 3 – FLASH KPIs

PRIMA	Depuy
• Assemble the FLASH full machine system integrated. • Validated FLASH hybrid robotic/CNC cell with integrated laser module. • Develop 1 final workshop. • Create the data management plan.	• Test 10 representative acetabular cup geometries. • Reach at least a 50% reduction in total machining time. • Elimination of process consumables and waste.
Diamoutils	TOFAS
• Microdrills: ◦ Evaluate the cutting response and durability of the micro drills. ◦ Assess the hole quality and structural integrity after being drilled with the microdrills developed by FLASH. ◦ Reducing material waste by up to 20% ◦ Delivering tools with a 10x longer lifetime. • Grinding Wheels: ◦ Conduct grinding trials on prepared workpiece blocks of 100Cr6 steel heat treated to 62-63 HRC to assess the grinding performance. ◦ Eliminating the polluting chemicals in processing the tools. ◦ Reduce process waste by 30%. ◦ Extending tool lifetime by 3 times.	• Conduct the following analysis in CCB: corrosion test, modal frequency, stiffness IP Attachment, steering column modal analysis, stiffness steering column and gearshift attachment, OBD connector stiffness, hood lever stiffness, manual park brake, torque-able fastener analysis, CCB KAB deployment strength analysis, CCB crash displacement, CCB PAB deployment strength analysis, IP knee impact, CCB Inertia Loads, IP Sag Analysis. • Process energy saving of 65%. • Weight saving of 1.5 kg per CCB.
Cailabs	3 Drivers
• Optimize the XY beam-shaping module. • Modify the co-axial gas assist nozzle and galvo scanner. • Tailor the beam profile for each process targeted by FLASH. • Develop a fibre switch to direct one or multiple laser beams into one of three beam delivery heads. • Validate the performance of the beam shaping and beam delivery heads.	• At least 1 scientific publication with LCA methodology and application of results. • 1 complete environmental data set per conventional laser technologies that the laser system will substitute as well as for the proposed laser system itself. • 1 set of relevant indicators for environmental impact assessment of the laser system in line with the EU Finance taxonomy technical screening criteria for the following objectives: climate change mitigation, climate change adaptation, transition to a circular economy and pollution prevention and control. • 1 set of relevant environmental indicators integrated into the digital decision model tool.
Cosmos Thrace	AIMEN
• Develop AI models trained to identify patterns, predict potential obstacles, make real-time decisions and	• Monitoring sensor will enable rapid process optimization loop over the full range of laser processes (cutting, welding, machining, micro-machining



- recommend the optimal processing-regimes.
- 1 Report on technical computational requirements and approach.
 - 1 Report of data analysis approach and results.
 - 1 software package containing an optimised model and all required infrastructure that can be deployed on the cloud platform.
- and micro-drilling), kinematic parameters, and laser sources (CW and ns at NIR, and green ns and us lasers) covered by the FLASH platform.
- Key outcomes for the high-power head, the scanner head and the WJGL head will be:
 - Defect detection, stability monitoring and issue detection, process reliability, breakthrough detection > 99% reliability, localization of defect for rework, estimation of the process stage of completion.
 - Direct productivity increases at least 10% and manufacturing yields of 99.3%.

ATOP - IMA

- FLASH will develop a laser-based process for hairpin skinning and joining, achieving a stripping rate of ~12 cm²/s, a ~70% increase in productivity compared to SOTA laser-based processes.
- FLASH will use hybrid dual beam welding to increase the laser absorption from 5% to up to 40%, enabling efficient welding with much lower average power (e.g. 3 kW) and an associated reduction in process energy consumption.

Weld quality will be improved through increased penetration (~6 8 mm) and reduced porosity, enabling reduced electrical resistance and improved performance of the resulting electric motors. Combined with the dual wavelength setup, online monitoring system, LCA guided process design tool, this approach is expected to reduce scrapage by 25% and energy consumption by 60%.

ROBUST AO GMBH

- Adapt the Zwobbel Technology to the two wavelengths at one mirror and show that it can work with both simultaneously.
 - The optical quality of the Zwobbel is suitable to be combined with dynamic beam shaping.
 - Collecting new sets of manufacturing parameters for accelerating processes by using Z-shifting
 - Bring ROBUST AO GmbH more into industry processes (laserwelding and lasercutting) as reliable supplier of adaptive optics for laser manufacturing
 - Scaling up the production of ROBUST AO.

Synova

- 3 laser units with associated fibre delivery, laser commissioning reports.
- Prototype fibre coupling module, and 3 lasers combined in a single fibre.
- A fully integrable BTS capable of collecting in-line processing data for 3 types of lasers and 3 types of heads.
- Optical module (3 lasers, fibre coupling module, fibre switch, optical and acoustic sensors) validated in lab-based testing.

ATS

- Types of new software solutions explored.
- Number of engineers upskilled.
- Time to deploy explored solutions commercially.
- Number of new services/products the business can market as part of this project.

MTC

HUD

- Development of innovative laser processing capabilities relating to:
 - Multi-wavelength and multi-beam delivery laser machining and joining.
 - Dynamic beam manipulation for laser machining.
 - Supersonic nozzle delivery of processing gas for laser machining.
 - Laser process development for ultra-hard/high-performance materials.
- At least 3 scientific publications relating to the experimental laser processing developments.
- At least 3 scientific publications relating to the simulation laser processing developments.
- Digital metrology solution for multiple laser processes.
- 2 technical conference/journal publication.

Value Chain and Routes to Market

Hereafter, in this chapter, an overview of the value chain of the FLASH system is presented encompassing possible Post Sale Services to be provided by the consortium partners to future clients.

Moreover, each partner has provided their input regarding the exploitation of results and outcomes of the project through an Exploitation form attached as an Annex I – Exploitation Strategy Form. This section is dedicated to the description of both the overall system value chain, but also partners individual exploitation assessment.

Overall system

The commissioning of the FLASH system will require the involvement of different partners that will play a very specific role in the value chain of the entire system. Even though the FLASH system will be commercialized by PRIMA, it is expected technical partners to play, besides providing hardware, an important role in training and support to PRIMA. The value chain of the FLASH system is illustrated in Figure 4 and discussed hereafter:

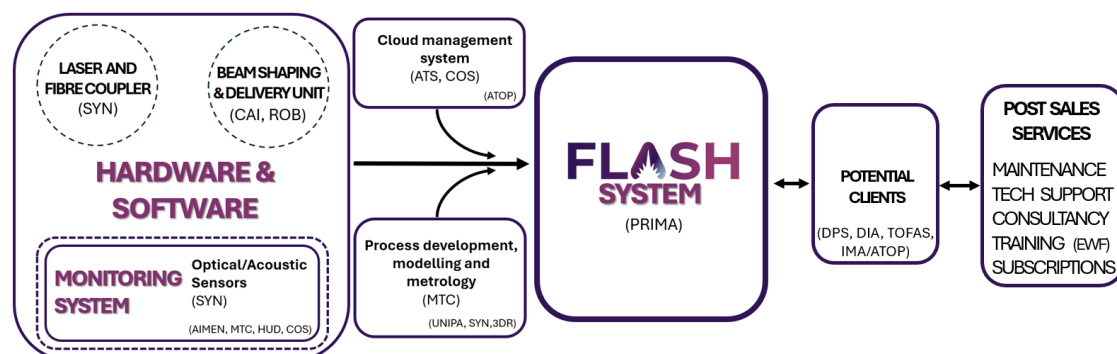


Figure 4 – FLASH Value Chain.

The FLASH project benefits from having a strong, industrial consortium that will ensure that all marketable results are achieved. However, the case study partners,



TOFAS, DPS, Diamoutils and ATOP bring clear and validated routes to the medical, automotive and advanced tooling markets for the FLASH platform:

- Depuy Synthes the orthopaedic implants leader, a Johnson and Johnson Company with annual revenues of €19.6BN in 2021.
- TOFAS has €1.4BN revenues with a production output of 230,000 vehicles in 2021 and is also part of the STELLANTIS Group, with €179.6BN revenues in 2022.
- ATOP/IMA is a leader in automatic machines to produce electric motors with, a wholly owned IMA Group company with 53 manufacturing sites globally with total revenues of >€1BN in 2020.
- DIAMOUTILS is a leader in advanced tooling, supplying global manufacturing companies in the aerospace, automotive, medical, and high-performance sports industries with a share capital of 500K€.

Alongside this, FLASH coordinator, Prima Additive, a wholly owned subsidiary of Prima Industries, with €408MN revenues in 2021, >1750 employees, 8 plants and customers spanning 80+ countries and >14K installed systems globally, is a leading machine solutions provider, well positioned to lead the industrial exploitation of the FLASH platform.

Moreover, it is important to highlight that partners will assess “Post Sales Services” to ensure that the client can have the best assistance after acquiring a FLASH System. The work to establish the “Post Sales Services” will be carried out during the second period and the following services are envisioned:

- Training
- Maintenance support
- Technical support
- Consultancy
- Subscription Services

Partners will work in collaboration to determine their involvement in the Post Sales Services. The final framework and details will be reported in Deliverable “D10.3 – Final business & exploitation plan, including PDEC report”.

Sales Forecast

PRIMA will be responsible for building and sales of integrated machines, providing a direct route to market for the FLASH machines through their existing sales channels as well as creating sales opportunities for each of the component providers for the full machine.

At this stage, considering that the technology is still being developed and tested, predicting sales is quite challenging. The capabilities of the machine will be its selling point and only after assessing them, it will be possible to understand exactly where the system will be positioned against its direct competitors.

Nevertheless, PRIMA forecasts sales of ~266 FLASH-IANUS systems for the first 5 years at an average system price of ~€907k. Including sales and aftersales, PRIMA forecasts revenues of €241M across the 5-year post-project period (2028-2032), the annual sales forecast for this period is listed in Table 4.

Table 4 – PRIMA FLASH-IANUS Sales forecast

2028	2029	2030	2031	2032	Total
------	------	------	------	------	-------



FLASH-IANUS Unit Sales	5	14	38	84	125	266
Price/machine (€)	950k	925k	900k	880k	880k	

The sales strategies for the FLASH-IANUS platform will be focussed on targeting organisations of various sizes, whilst smaller manufacturers may only purchase one FLASH-IANUS platform, larger organisations such as TOFAS and DPS will likely purchase multiple platforms to ensure full coverage. In addition to the sales directly generated by PRIMA, the consortium partners supplying hardware or services will also sell their newly developed products to other relevant applications.

Individual partners assessment

The FLASH consortium partners have also delineated their strategy for their exploitation plans. This information was gathered through a form specifically developed for FLASH, which is attached in Annex I. The document provides an overview of how the exploitation of the outcomes and results of the project are expected to be done and how the connection will be made between the overall system and the sub-systems of FLASH. In Table 5 is possible to find the technologies to be commercialised and expected values.

Table 5 – FLASH commercial offering and expected values.

Partner	Technology to be commercialised	Number of units	Cost (€)	Cumulative revenues 5 years post-project (€)
PRIMA	FLASH-IANUS system	266	4M	241M
SYNOVA	High-power waterjet-guided nozzle	266 + aftersales	1M	120.4M
ATS	Digital solution for machine tools	488 + extra processes	0.5M	5.4M
Cailabs	Beam shaping and laser heads	1108	1M	44.6M
ROBUST AO	z-axis shifting module	947	0.7M	9.78M
3 Drivers	LCA design module	NA	0.3M	4.69M

To access the forecasted business opportunity, the market and potential customers need validated proof of performance of the FLASH platform and other technologies beyond TRL7. All the industrial partners have experience in facilitating technology transfer beyond TRL7 and commercialisation. The industrial partners will leverage their existing portfolio of capital (proportion of company profit; innovation loan(s) and grants from regional governments and investor capital) to further develop FLASH (TRL7>9). Initial commercialisation costs are expected to be ~€7.2M, expecting to break even after selling ~14 units, within the first 2 years after commercialisation. All the technology providers are currently embedded in relevant supply chains and will use their existing production capability and invest as necessary to meet demands. The industrial partners have direct access to the markets and will be selling the products directly to their customers through their existing sales and support network.

**Synova (SYN) will exploit the following KERs:**

- Dual Green combined (short pulse and long pulse) laser beam through the Water jet guided laser, for more reliable thicker (1-20mm) cutting, and cut surface quality
- Simplified process monitoring learning on multi-sensor systems using AI.
- Streamlined integration of a Laser Micro-Jet system into a robotics platform.
- Business case for the Synova Fiber Coupling Module (modified for Flash) as a standalone offering for laser processes other than the Laser Micro-Jet

SYN has a well-established sales strategy focused on building and supplying laser cutting solutions based on the Laser Microjet® water-guided cutting system. SYN has a wide-ranging network of customers across the world with a focus on EU and, North and South America, that operate in almost all major industries, especially in medical device manufacturing and aerospace component manufacturing.

The current product range includes entire Laser Cutting Systems (LCS) ranges tailored for various applications, as well as offering the Laser MicroJet® Integration Package (LMJ-IP) which includes the core components required for the waterjet head: optical head, laser sources and water pump. Through the developments in FLASH, SYN will establish the FLASH-LMJ-IP, a tailored package designed for integration into the FLASH-IANUS platform which will include the new fibre coupling unit and process monitoring module.

The FLASH-LMJ-IP will be sold as a complete package at a sales price of €450k/package, and it is forecasted to be sold/year at least 30 FLASH-LMJ-IP kits by 2032.

The fibre-coupling module will be a standard offering for the overall FLASH-IANUS platform. However, some customisation will be possible (e.g., adaptation of the laser sources for specific customer needs). However, this customisation will be chargeable (~€20-50k per customisation) and will still be specifically for the FLASH-IANUS platform. It is forecasted to be sold/year at least 20 FLASH-LMJ-IP kits by 2032.

Also, based on the forecast FLASH-IANUS sales, SYN will generate €119.7M in revenues across the first 5 years. In addition to the direct product sales, aftersales are expected to generate a further ~25-45% (€29.5M), covering out-of-warranty maintenance, spare parts and application support (i.e. helping customers achieve increased performance on their machine, or diversifying uses). Additional sales of the full FLASH-LMJ-IP package beyond PRIMA are not expected, however, there will be additional sales opportunities within PRIMA for integration into non-robotic cells of some of the FLASH-developed components. In the longer term (> 5 years post-project). The combined revenues for SYN forecast for the 5-year post-project are €149.9M with profits of €37.6M. To facilitate this growth in sales, ~150 new jobs will be created across sales, manufacturing and aftersales.

Cailabs (CAI) will exploit the following KERs:

- Fibre switch to direct one or multiple laser beams into one of three beam delivery heads.
- Dynamic beam shaping solution for X-Y shaping.

CAI has an existing business model that focuses on building strong sales relationships with system manufacturers and integrators, avoiding the need to build a large sales team. Long-term sales agreements with integrators offer stability and profitability for CAI. CAI anticipates that all components will be supplied to PRIMA as a package, however, there will be scope to supply some components in addition to the FLASH



system sales. The FLASH developments will fit under the 'CANUNDA' beam shaping module product line, which is focused on laser material processing. The CANUNDA product line currently offers standard, customised and application-specific products for laser beam shaping. It is expected that the development of the FLASH product will become a customisable offering focused on addressing the needs of flexible laser machining requirements.

CANUNDA-HP-FLASH will be an upgrade of the top-hat and ring shaper providing more flexibility to enable different laser processes. The full CANUNDA-HP-FLASH package includes: 3x X-Y beam shaper(s) (2x shapers for the gas-nozzle for cutting and welding and 1x shaper for the galvoscanter), 1x fibre switch and 2x heads (gas-nozzle and galvoscanter). This full CANUNDA-HP-FLASH package is forecast to be sold to PRIMA initially for €128K (for quantities of 5-19) and then larger volumes >20 for €104K. These bulk orders offer economies of scale that can bring the component costs down (10-20%). Based on forecast FLASH-IANUS platform sales, CAI will generate direct revenues of €28.1M, with an average package sales price of €130k. In addition to sales directly via PRIMA, CAI anticipates that dual-wavelength (incl. shapers) beam delivery heads and the beam shaper components could be sold separately.

CAI has an existing sales network that already includes several laser-head manufacturers and system integrators, of which multiple would have interest in the beam delivery heads and shaper modules. CAI expects to sell beam-shaping modules to laser-head manufacturers and laser-heads to machine manufacturers and end users. The target is to open one new major account per year (either laser-head manufacturer or machine manufacturer) alongside the end-user sales. The shaping module will be of high interest for e-mobility applications and other cutting applications and CAI expects to be able to sell ~647 shaping modules, alongside ~195 laser-head sales in the 5-year post-project period. These additional sales will generate revenues of €16.4M. Overall, FLASH will deliver combined revenues of €44.6M with combined profits of €26.7M. To facilitate this growth in sales and in-house production, ~114 new jobs will be created across product sales, manufacturing and aftersales.

ROBUST AO (ROB) will exploit the focus shifting.

ROBUST AO is a start-up currently commercialising the Zwobbel® technology. FLASH will enable ROB to develop a second-generation product better aligned to the needs of the FLASH system, with the key differentiators being a mirror capable of accommodating FLASH wavelengths and oscillation frequencies up to 1000 Hz.

The second generation Zwobbel® will offer better compatibility with higher laser power and better performance in both the gas-nozzle and galvoscanter beam delivery heads. A complete Zwobbel® will sell for ~€12.5K per device (reducing to €11K at volumes over 100) and each FLASH platform will require 2 Zwobbel devices (one each for the gas-nozzle and galvoscanter). Based on the direct supply for the FLASH-IANUS platform, ROB expects revenues of €5.9M. Additionally, the second generation Zwobbel® will offer enhanced performance in applications such as 3D manufacturing with laser power bed fusion (LPBF), laser pinching (faster pinching vs traditional methods) and addressing multiple beam intensities in laser welding. There will also be a broader demand for copper laser welding applications. These additional applications are expected to achieve sales of ~289 units generating revenues of €3.2M. ROB's assumption is that ~30% of Zwobbel® devices will need to be replaced (electronics can remain) per year, based on the deterioration of the coatings and mechanical elements. Replacement Zwobbel® components are forecast to generate revenues of €631k.



Overall, the developments in FLASH will generate cumulative revenues of €9.74M with cumulative profits of €3.56M for ROB over a 5-year post-project period. To facilitate this growth, ROB expects to require investments of €0.7M to scale up production, as well as create at least 15 new jobs across the business.

ATS will exploit a database with simulation and a digital metrology package.

ATS' Cloud platform is a Software-as-a-service solution to increase efficiency and enable all businesses of any size, from any industry to harness the potential of Industry 4.0. The unique value proposition of FLASH, where multiple manufacturing processes will be completed in one platform, will be a significant step-change in most manufacturing operations and will need a change in protocols and logistics, however more importantly, the new FLASH-based processes will be digitally controlled, therefore the data capture, handling and processing is vital.

Each FLASH-IANUS platform will be sold with a subscription to the Cloud. The Cloud comprises 3 different services which will be covered with one subscription. ATS-Cloud will however offer some personalisation focussed on the specific setup options for the cloud: public-private, virtual-private, and private. Cloud-based deployment option involves hosting on public cloud infrastructure, such as AWS, Azure, or GCP – offering flexibility and scalability of cloud computing with no maintenance burden. On-premises installations involve installing Cloud on their own servers or data centres – ideal for specific security or compliance requirements. Organisations will be free to choose the option that suits their needs, and the cloud deployment costs will vary between setup options. The Cloud will be managed based on the 'number of processes' completed and as all FLASH-production steps will be completed in one platform – one process is assumed to be a complete manufacturing cycle. It is assumed that most organisations will opt for a mid-level subscription 'Business' which is based on 750 completed processes (Enterprise is 3k processes).

The subscription fees for Cloud 'Business' expected are: €463/month (public cloud configuration); €613/month (virtual private cloud) or €276/month (private cloud). Every FLASH-IANUS platform will be sold with a Cloud as standard, however, organisations with multiple FLASH-IANUS platforms will be moved to the 'Enterprise' level and will require only one subscription across all machines. For example, DPS would be at the enterprise level with a single subscription as they will adopt multiple platforms and would be charged by the total number of processes completed across all machines (per process costs will range across the cloud setup options: public (€0.45/process), Virtual (€0.60/process) or Private (€0.25/process).

For forecasting purposes, the assumptions are: 'business' subscription and public cloud configuration. Based on the FLASH system sales expected, ATS forecasts cumulative subscription revenues of €5.41M over the 5-year period, which covers Cloud subscriptions, additional manufacturing process costs and setup costs.

3 Drivers (3DR) will exploit the process design package for laser-based manufacturing linked to the LCA digital decision model.

3DR is an environmental consultancy with over 17 years of experience supporting clients to improve the sustainability of their businesses, placing the focus on the assessment and improvement of the environmental performance of products and services.

Within FLASH, environmental impact indicators and LCA methodology will be integrated into a digital decision tool that will identify the correct process design. Designers and engineers will be empowered with an LCA digital database to help



establish a decision-making process that integrates environmental considerations into the development of processes that can be completed with the FLASH platform, through an LCA-design module. 3DR will scale this up to commercialisation with an initial version focussing on an open-source digital database to enable faster roll-out without limiting the compatibility to mainstream inventory packages. Further development of the module will involve building a more advanced database, and specific plug-ins for commercial packages such as Ansys, Siemens NX, SolidWorks and Revit, amongst others.

Product designers in all manufacturing industries that utilise the aforementioned packages will be target customers eventually, with an initial focus on designers/developers that need to design more sustainable products and production processes. The LCA-design module will be made available to customers either as a standalone package or as part of a sale of an overall FLASH unit. As a standalone package, the LCA design will be available for a one-off fee; discounted for FLASH machines at €12.5k, and €15K for other non-FLASH system-based applications. Ongoing support will be available as requested and annual chargeable updates will be offered at €1k/license. Based on this model, 3DR forecasts revenues of €3.32M from FLASH licenses, and €1.08M from direct sales to other customers. Annual updates are expected to generate €285k. In total, 3DR forecast revenues of €4.69M across the 5-year post-project period (2028-2032). This will result in a new business area, as a new service will be offered.

Cosmos Thrace (COS) will exploit the Machine Learning algorithm for design for laser-based manufacturing.

Cosmos Thrace is a technology-driven SME that provides customized and efficient data management solutions for global customers. COS uses business intelligence (BI) and artificial intelligence (AI) technologies to help its clients optimise their business processes, reduce costs, and gain a competitive edge. COS has a team of experts with experience in data strategy, database migration, software development, and AI applications. COS has developed and commercialised multiple unique AI solutions, including via the creation of spin-out companies.

Within FLASH, COS will develop the methods to apply machine learning (ML) to better predict and recommend the optimal processing regimes across all capabilities offered by the FLASH-IANUS platform. COS will host and maintain the algorithms in their containers. ATS will connect to the most up-to-date version of the algorithms via an API which will be configured in a task within a process. During this project, a service agreement will be established between COS and ATS which will outline the commercial model. A typical model would be based on a per-process fee payable to COS by ATS – this per-process fee will likely be between €0.20-0.30 per process, subject to negotiation. This will be sold to medium and large companies with products requiring the application of ML algorithms to determine machine and/or materials properties, directly with B2B customers looking for innovative approaches in their current production. Based on the number of FLASH-IANUS platforms sold, Cloud subscriptions sold, and the estimated manufacturing processes completed, the forecast revenues for COS for the 5-year post-project period are €1.97M.

The Manufacturing Technology Centre (MTC) will develop models and metrology solutions to a database of parameters and outcomes.

The MTC is an industrial-scale factory demonstration facility where technology can be refined and tested in close collaboration with industry. The centre has a number of key research themes including Intelligent Automation, Advanced Tooling & Fixturing,



and Metrology. In the project, they will focus on the development of innovative laser processing capabilities relating to multi-wavelength and multi-beam delivery laser processes, dynamic beam manipulation for laser machining, supersonic nozzle delivery of processing gas for laser machining and laser processing of very hard materials. Additionally, MTC will develop high-fidelity multi-physics laser-based manufacturing simulation techniques in dissimilar laser welding, water Jet Guided Laser machining, and supersonic nozzle gas dynamics for laser machining.

Their market is global, focusing on the UK and EU in fields such as aerospace, automotive, automation, power & energy, tooling, medical and electronics.

The FLASH project will allow the MTC to advance current capabilities in an array of laser-based manufacturing processes, and exposure to advanced laser and artificial intelligence technologies. Additionally, it will allow the MTC to enhance its capabilities in laser manufacturing process optimisation by exploiting the simulation and AI capabilities generated by the project. This will lead to a direct reduction in the need for expansive experimental process development, reducing laser system energy consumption and material usage.

IMA-ATOP will exploit the laser-based process for copper hairpin stripping and welding.

ATOP, is a company part of the IMA Group leading in the manufacture of machines and automatic lines for the production of electric motors for several industrial and automotive applications, including e-mobility. ATOP manufactures production lines that guarantee the utmost performance in the assembly of traction hairpin stators.

IMA-ATOP operates in the global market, focused on the automotive industry with a potential market size of 1BN€/year. It foresees sales numbers after 5 years post technology market entry of 50MLN€/year. The FLASH equipment will be integrated into ATOP's offer of full manufacturing lines to produce hairpin motor stators, more precisely for welding, stripping, and mechanical stripping. This will allow more precise machines, with less scrap, faster production and a more energy-efficient machine.

AIMEN will develop the acoustic & optical sensor fusion array to enable process verification and validation.

AIMEN is a private non-profit association, in which their daily activity is concentrated on applied research, technology development and innovation.

In the FLASH project, they will develop a universal in-process monitoring solution, based on acoustic and optical sensors to deliver a stable manufacturing process suitable for unsupervised 24/7 processing in industrial environments. They operate worldwide, mainly in Western countries, with a focus on different markets including aerospace and automotive.

Considering that technical partners are still developing the technology to be implemented in the FLASH system, there are still some exploitation points that are unknown and highly dependent on the results of the experiments. Thus, some information will be updated as the results are achieved during the second period of the project.



Customer Segments

PRIMA is responsible for the commercialization of the overall FLASH system and has identified that the main clients for the system are those looking for high-added value products.

Based on the potential customers within the project, as well as the networks already in place, the customer targets in the first years of commercialization are listed in Table 6.

Table 6 – Target Industries and potential customers by sector.

Sector	Target Industries/Costumers
Healthcare	DePuy Synthes, Stryker, Zimmer Biomet, Smith & Nephew, Medtronic Spine
Aerospace	Rolls Royce, Airbus, GE Aviation, Pratt & Whitney, Honeywell Aerospace, CFM International, Pyromeral, Avio, Safran, MTU, Dassault, SAAB, BAE and Boeing
Automotive	TOFAS, ATOP, Teknorot, Marelli, Tenneco, Robert Bosch GmbH, ThyssenKrupp AG, Faurecia
Tooling	Diamoutils, Reaction Engines, Sandvik Coromant, Element Six, Seco Tools, Guhring, Mapal, YG-1, 3M
Semiconductor	NXP Semiconductors, Aixtron, Soitec, Elmos, Applied Nanolayers

Moreover, the consortium has and will continue to investigate more applications that may be relevant for the usage of the technology. This will be done at a later stage after completing the testing of the system and assessing its full capabilities. So far, further examples where FLASH will deliver a significant advantage over existing technologies include:

- **Manufacturing of gas turbine blades:** Currently manufactured using 4 different laser-based manufacturing machines, which could be replaced by a single multi-step FLASH process, reducing machining time from 6 hours to approximately 4 hours per component.
- **Manufacturing of micro-as turbine inner cores:** Currently manufactured via spinning, CNC edge trimming, long pulse laser drilling and grinding process, using multiple fixtures, and moving the parts between four machines. FLASH (CW cutting and WJG drilling parameters) would enable single-machine manufacturing, whilst overcoming existing challenges associated with delamination of thermal barrier coatings.
- **Machining of ceramic matrix composite-based components for space applications:** The hybrid pulse capability of the FLASH system will enable productive cutting, drilling, and blind machining of advanced materials without significant thermal damage. This will open the exploitation of new advanced materials across the engineering sector, e.g. ceramic matrix composite (CMC) based rocket nozzle inserts.
- **Thick-section laser drilling and cutting of metals, alloys and ceramics:** For example, dual beam laser drilling (using 1070 nm and 532 nm), will enable the drilling of high-aspect-ratio holes over thick alumina material (20-30 mm) - the ns green laser beam will increase the dual laser beam absorption and increase melt ejection resulting in high speed and high-quality drilling of high aspect ratio holes over challenging materials.
- **Machining of zirconia toughened alumina (ZTA) based ceramic insert for orthopaedic implants:** The use of ceramic (e.g. ZTA) inserts as an interface between

the Acetabular cup and the femoral head of a hip implant has been demonstrated to provide reduced wear rates vs other materials (e.g. polyethylene). However, both conventional and non-conventional machining of ZTA ceramic is challenging due to its high hardness, brittleness, and low absorptivity. Application of both long (μs) and short (ns) pulse green lasers with a combination of galvoscaner and WJG laser processing with FLASH (macro machining, coupled macro and micro polishing, surface texturing) could overcome existing challenges and offer improved tribological surface performance.

Background IP identified by partners.

From the Grant Agreement, this is a brief description of the IP Strategy that will be adopted by the partners in the FLASH project:

FLASH will follow a defined RAPID process that will cover the management of intellectual property that is both brought to the project as background and developed during the project as foreground. As the project develops, all outputs will be Recorded as part of the FLASH IPR Portfolio, assessed for their potential to be exploited and protected as necessary. Following protection, the individual exploitation strategies for each output will be Implemented before Dissemination occurs.

To identify what needs to be protected the partners will rely on the schematic shown in Figure 5 to identify what results are possible for protection.

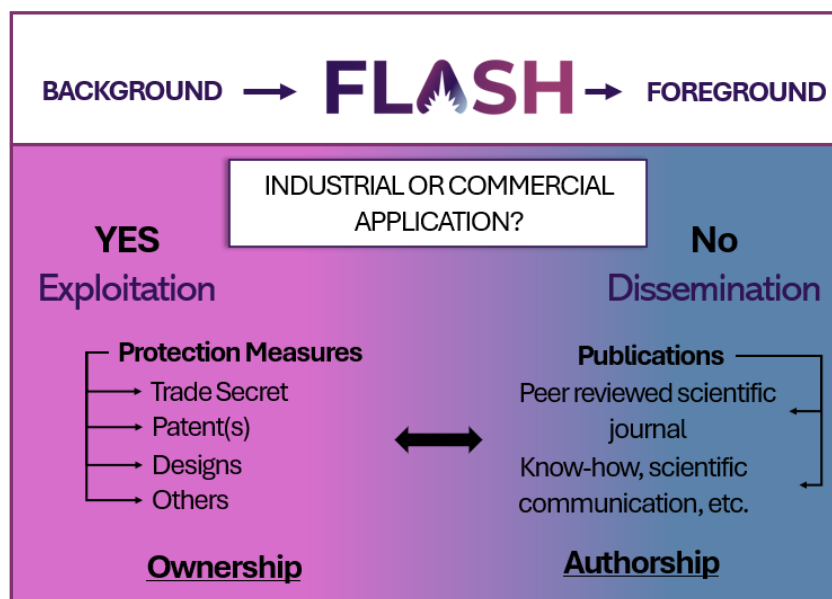


Figure 5 - Ownership vs. Authorship of project results.

Ownership vs. Authorship of Project Results

At the initial stage partners already identified their background IP, which is presented in Table 7. The information provided in this table, based on the CA and GA, will serve as a reference to identify and distinguish the results coming from the project, and the routes to exploitation and protection, and will be updated on a semester basis, if needed.

Table 7 – Partners' background IP

Partner	Background (IP & IPR)
PRIMA	Modular machine platform capable of automated head selection, with hybrid robotic/CNC control.

Cailabs	• Know-how related to the design and manufacturing of beam-shaping solutions based on multi-plane light conversion. • Patents related to the design and manufacturing of beam-shaping solutions based on multi-plane light conversion. • Fibre switch to direct one or multiple laser beams into one of the three beam delivery heads. • Dual-wavelength galvo scanner delivery head • Dynamic beam shaping solution for X-Y shaping
3Drivers	• All background owned by 3Drivers and related to the project: life cycle inventory (LCI) and life cycle impact assessment (LCIA) data and information. • Process design package for laser-based manufacturing linked to LCA digital decision model.
Cosmos	• Expertise in developing methods to apply machine learning for prediction and recommendation of processing regimes across platforms. • ML algorithm for design for laser-based manufacturing.
ROBUST AO	• Z focus shifting.
ATS	• Database with simulation and digital metrology package.
AIMEN	• Know-how in the development of monitoring solutions based on optical emission spectroscopy during the process and inline light reflection monitoring throughout the optical fibre. • Expertise in the development of optical and acoustic monitoring systems, knowledge of acoustic signal analysis and acoustic triangulation during manufacturing processes. • Acoustic monitoring sensor. • In-process monitoring & control module based on a second-generation optical breakthrough and intensity detection sensor (Partial IP Owner).
SYNOVA	• Waterjet Guided delivery head. • In-process monitoring & control module based on a second gen optical breakthrough and intensity detection sensor (Partial IP Owner).

Standard Operating Procedure for Exploitation

Standard Operating Procedures (SOP) for exploitation are presented hereafter and will ensure that commercially relevant results are not prematurely disclosed.

A procedure was developed to facilitate the assessment of exploitation strategies in a standardized and practical way for every project result while complying with the IP management rules in Horizon Europe projects. This exploitation SOP is divided into four stages:

1. Classification of exploitation interests
2. Identification of active contributions and ownership models
3. IP protection measures
4. Innovation management

Classification of exploitation interests

The discussions for the classification of exploitation interests have already started in the proposal with the list of expected results. However, in the SOP, such discussions will be reactivated with the evaluation of the progress report and the TRL assessment of each exploitable result. As aforementioned, the partners must exploit the results by,



using them in further research activities; developing products or processes; providing a service, or through standardization. This classification can only be completed with the Final TRL assessment e.g. a prototype will lack commercial value if it has a low TRL or if the market is not ready for its commercialization. In consequence, the exploitation interests of the owners of the results may change during the project depending on the final status of the technology achieved.

According to the Grant Agreement *“Beneficiaries which have received funding under the grant must adequately protect their results — for an appropriate period and with appropriate territorial coverage — if protection is possible and justified, taking into account all relevant considerations, including the prospects for commercial exploitation, the legitimate interests of the other beneficiaries and any other legitimate interests.”*

During the project, partners will be required to complete a set of questionnaires and interviews to determine a list of project results, ownership and respective TRLs. The exploitation interests will therefore constitute the basis for business model(s) that evolve in the following steps of the SOP.

Identification of active contributions and ownership models

The main principle concerning ownership of the results is that “Results are owned by the beneficiary that generates them” (Grant Agreement). However, there might be cases where two or more partners have been working together in the development of a single result. In those cases, it is necessary to determine the owner(s) of the result considering that owners of the results are obliged to use them and protect them adequately during or after the project completion.

Partners are encouraged to familiarise themselves with the “Joint Ownership” concept to differentiate the “background inputs” and “active contribution”.

According to the Grant Agreement, “the joint owners must agree (in writing) on the allocation and terms of exercise of their joint ownership”. This means that whenever there is a case of “Joint Ownership”, all active contributors to a result shall decide, coordinated by the Project Coordinator and supported by EWF, which of the participants involved will be assigned as the owner(s) of the exploitable results taking into account the following questions:

- Capabilities of the potential owner(s) to bring the results to the market.
- Identification of conflicts of interest within the consortium (e.g. to prevent granting a license to a competitor within the consortium).
- Fair & reasonable compensation to the active contributors (Access rights agreements).
- IPRs owners’ benefits, exploitation limits and responsibilities, among others.

Ownership agreements might be also linked to exploitation interests. The ownership agreements should define the timeframe and investment plan for IP protection measures and business model implementation. This ensures transparency regarding the return of their investments in the same proportion of their contributions as well as their obligations towards the exploitation of such results. However, this is not compulsory. Nevertheless, it is important to regulate the implementation of the exploitation plan throughout private agreements. In this sense, there might be joint venture or spin-off established by the partners for the further development and exploitation of the project result(s) whenever two or more partners are involved in a single business model.



IP protection measures

The owner(s) of the results should discuss and decide the suitable Intellectual Property Rights (IPRs) to protect them adequately. This will also depend on the TRL of the result keeping in mind that industrial or commercially exploitable outcomes should be protected if it is “*possible, reasonable and justified*”. This might not be the case for a result/prototype with a low TRL.

The coordinator and the WP9 leader will together support all members of the consortium on the identification of protectable subject matters by regularly requesting updates to the questionnaire. Nevertheless, it is up to the owner(s) of the results to implement such measures and to regulate the use of their intellectual property rights through the negotiation of exploitation agreements under the structure of a business model. IP protection measures might require a significant investment of resources and time that must be taken into consideration before the implementation of the exploitation strategy. Finally, owners of the results should understand that obtaining the registration certificate of IPR (e.g. a patent or a trademark) does not automatically protect the result from any potential infringement since it is up to the IPR owners to take the pertinent action according to the law of the country where the protection is sought.

Innovation management

To consolidate the business model for its implementation, the owner(s) of the results should analyse the market insights e.g. on prices and competition, legal/regulatory conditions etc. and possibilities for commercialization and/or needs/issues for further research and development to increase the TRL. Partners will be asked to consider competitor analyses, position & pricing strategies (SWOT), starting production costs, approximate initial investment, and approximate time for return of the initial investment to establish the business case. In case the owner(s) of the results with the commercial or industrial application are not willing or able to develop an exploitation plan, the Executive Board should consider what other exploitation strategies could be feasible.

The General Assembly is the final decision-making body. The extent to which business planning is pursued will depend on the results at hand, the known market insights and of course, the partners involved. Ideally, business models as well as post-project plans and agreements should be prepared during the project lifetime whilst funding is still available so that commercialization can be pursued as quickly as possible.



Conclusion

The interim exploitation framework represents a critical step forward in optimizing our operational strategies and leveraging our resources for maximum impact. Through careful analysis and strategic planning, we have established a framework that aligns with our project goals and objectives. It includes the initial plan for exploitation, and as the project evolves this will be updated accordingly with the latest outcomes and intentions regarding exploitation.



Annex I – Exploitation Strategy Form.

Project Result Designation (the result from your organization)	
Project Result Description	
GROUP I	
1. Explain what are the key business goals for the exploitation of this result.	
e.g.: sales increase for existing products, new markets and clients, cost reduction, etc.	
2. Considering the current markets where your organisation operates, refer in which the FLASH results will be exploited:	
3. For the above markets, fill in the following table. <i>For accuracy, please provide data sources for all topics.</i>	
3.1 Geographic characteristics	e.g.: Location, etc.
3.2 Industrial sector/application	e.g.: Automotive, Medical, ...
3.3 Customer profile	e.g.: other companies, the final user
3.4 Potential Market Size	e.g.: Demographics, relevant numbers
3.5 Existing Competing Technologies	e.g.: other machine manufacturers
3.6 Foreseen sales numbers after 5 years after market entry	If possible, detail expected numbers per year
3.7 Exploitation strategy/roadmap	Direct sales to customers, service providers using the project result, or both.
3.8 Penetration strategy	How will you ensure market uptake of the result?
4. Detail the costs associated with the exploitation of results. <i>Provide absolute numbers per sale, or accumulated over 5 years, considering sales numbers.</i>	
4.1. Direct Costs	e.g.: Production, sales, salaries
4.2. Indirect Costs	e.g.: Marketing, overheads?

GROUP II			
1. Besides the potential commercial exploitation of the FLASH result, consider the categories below and answer when possible:			
1.1. Can this project result lead to an increase in your organisation's employees' number?	Yes	No	
	If yes, please detail next:		
1.1.1. Number of potential new employees, after 5 years			
1.1.2. Profile of the new employees <i>White and/or blue collar, detailing the job function</i>			
2. Will your organisation benefit from the FLASH results in terms of:			
	Yes	No	If yes, please detail:
2.1. Innovation capability			e.g. a new product, a novel design for an existing technology, etc.
2.2. Sustainability			e.g. energy savings, material utilisation, process optimisation
2.3. Growth			e.g. new business area, new markets, increase in sales numbers, etc.
2.4. Product value chain improvement			e.g. reduced costs for your organization, benefits for your customers



3. Will you engage with other project partners to exploit the results?	
4. How have you identified your market, its size, and characteristics?	
5. Will you seek certification for this result (e.g. CE marking)? Please describe why.	
6. Please describe the expected difficulties in exploiting the FLASH results:	
6.1. Necessary steps to begin exploitation	The product may not be market-ready, further technical development is needed, etc.
6.2. Exploitation strategy not yet defined	Where, how, and to whom will the result be exploited?
6.3. Internal challenges	Low engagement with sales/marketing department, etc.
6.4. Other	
7. Please describe any contingency plans to be put in place to mitigate exploitation risks:	
8. To ensure the exploitation of results, what are the funding needs for your organization?	
9. How will you obtain this funding? Internal funding? National or Regional funding? Other European project proposals? Other?	

GROUP III		
Regarding the implementation of the technology/machine in your own company.		
1. Please fill out the SWOT analysis, with 1-5 points per category, considering the goal of exploiting the project results:		
S trengths		W eaknesses
O pportunities		T hreats
2. Please fill out the PEST analysis:		
P olitical		E conomic



Social		Technological	
3. What will be the financial benefits to your company?			
4. Will your company benefit from resource-saving (less scrap)?			
5. Regarding the implementation of the technology/machine in the end-users, please describe:			
Benefits			
Risks			
Difficulties			
Barriers			



Exploitation data collection form – ATS

Identification
Partner's Name
ATS Applied Tech Systems Ltd

Project Result Designation (the result from your organization)	
Project Result Description	Knowledge and Software Solution Processes
GROUP I	
1. Explain what are the key business goals for the exploitation of this result.	
Increase in sales, increase in project margins, improve customer satisfaction	
2. Considering the current markets where your organisation operates, refer in which the FLASH results will be exploited:	
Aerospace, automotive, defense manufacturing	
3. For the above markets, fill in the following table. <i>For accuracy, please provide data sources for all topics.</i>	
3.1 Geographic characteristics	UK
3.2 Industrial sector/application	Aerospace, automotive, defense manufacturing
3.3 Customer profile	SMEs and large manufacturing companies
3.4 Potential Market Size	The global laser processing market size was valued at USD 17.48 billion in 2021
3.5 Existing Competing Technologies	In terms of connectivity, the challenge is that the machine data is usually 'locked' by manufacturers needing significant investment to be unlocked and it is likely that the embedded systems have minimal integration capabilities with other manufacturing systems.
3.6 Foreseen sales numbers after 5 years after market entry	500 machine deployments
3.7 Exploitation strategy/roadmap	Direct sales to customers, or through collaboration with the project partners
3.8 Penetration strategy	Laser processing will be market driven for our business
4. Detail the costs associated with the exploitation of results. <i>Provide absolute numbers per sale, or accumulated over 5 years, considering sales numbers.</i>	
4.1. Direct Costs	TBD
4.2. Indirect Costs	TBD

GROUP II		
1. Besides the potential commercial exploitation of the FLASH result, consider the categories below and answer when possible:		
1.1. Can this project result lead to an increase in your organisation's employees' number?	Yes	No
1.1.1. Number of potential new employees, after 5 years	10 employees	



1.1.2. Profile of the new employees <i>White and/or blue collar, detailing the job function</i>		Project Managers, Deployment Engineers, Connectivity Engineers, Data Engineers	
2. Will your organisation benefit from the FLASH results in terms of:			
	Yes	No	If yes, please detail:
2.1. Innovation capability	X		Offering latest technologies on connectivity to our customers
2.2. Sustainability			
2.3. Growth	X		Knowledge on machine connectivity of new processes and machines
2.4. Product value chain improvement	X		Faster deployment time leading to improved project margins and better customer satisfaction
3. Will you engage with other project partners to exploit the results?			
Potentially yes			
4. How have you identified your market, its size, and characteristics?			
Our market size is not specific to laser processing and therefore it's hard to quantify			
5. Will you seek certification for this result (e.g. CE marking)? Please describe why.			
No			
6. Please describe the expected difficulties in exploiting the FLASH results:			
6.1. Necessary steps to begin exploitation	Laser processing will be market driven so identifying customers who specifically need laser process integration will be challenging.		
6.2. Exploitation strategy not yet defined	The results will be exploited into various industries and processes beyond laser based manufacturing		
6.3. Internal challenges	Lack of marketing alignment on laser based manufacturing, lack of strategy in engagement and partnership with laser machine manufacturers		
6.4. Other			
7. Please describe any contingency plans to be put in place to mitigate exploitation risks:			
Results can be exploited across various industries and manufacturing processes			
8. To ensure the exploitation of results, what are the funding needs for your organization?			
Marketing and business development			
9. How will you obtain this funding? Internal funding? National or Regional funding? Other European project proposals? Other?			
Internal Investment			

GROUP III	
Regarding the implementation of the technology/machine in your own company.	
1. Please fill out the SWOT analysis, with 1-5 points per category, considering the goal of exploiting the project results:	
S trengths	W eaknesses



Strong technological capabilities demonstrated through achieving expected TRL advancements. Diversified portfolio of laser-based processes for various industries. Successful integration of multiple laser sources and beam delivery heads. Collaboration with reputable partners and end-users enhances credibility. Project results align with market demand for advanced manufacturing solutions.	Lack of defined exploitation strategy and marketing alignment for laser-based manufacturing. Uncertain direct and indirect costs associated with result exploitation. Dependency on market-driven approach may lead to challenges in customer identification. Limited clarity on resource allocation for upskilling engineers and deploying solutions commercially. Potential difficulty in differentiating from existing competing technologies in the market.
--	--

Opportunities	Threats
Emerging markets in aerospace, automotive, and defense manufacturing offer growth opportunities. Increased demand for advanced laser processing solutions due to industry trends towards automation and efficiency. Potential for expansion into new geographical regions beyond the UK. Opportunity to leverage project results for innovation capability and product value chain improvement. Collaboration with project partners can lead to synergies and enhanced market penetration.	Market competition from established players offering similar laser processing solutions. Economic fluctuations impacting investment decisions in manufacturing technologies. Regulatory hurdles or certification requirements affecting market entry and product adoption. Technological advancements leading to rapid obsolescence of current solutions. Risk of intellectual property infringement or imitation by competitors.

2. Please fill out the **PEST** analysis:

Political	Economic
Stable political environment in the UK may provide conducive conditions for business operations. Government policies supporting innovation and technology adoption can be beneficial.	Economic factors such as GDP growth and manufacturing output may influence market demand for laser processing solutions. Fluctuations in currency exchange rates could impact international sales and revenue generation.

Social	Technological
Increasing emphasis on sustainability and efficiency in manufacturing processes may drive demand for laser-based solutions. Changing consumer preferences towards customized products may necessitate flexible manufacturing technologies.	Rapid advancements in laser technology and connectivity solutions offer opportunities for innovation. Integration of Industry 4.0 technologies can enhance the competitiveness of laser processing solutions.

3. What will be the financial benefits to your company?



Increased Revenue, Improved Profit Margins, Enhanced Brand Reputation	
4. Will your company benefit from resource-saving (less scrap)?	
N/A	
5. Regarding the implementation of the technology/machine in the end-users, please describe:	
Benefits	-
Risks	-
Difficulties	-
Barriers	-



Exploitation data collection form – Cosmos Thrace

Identification
Partner's Name
Cosmos Thrace

Project Result Designation (the result from your organization)	-
Project Result Description	Develop new AI models trained to identify patterns, predict potential obstacles, make real-time decisions and recommend the optimal processing-regimes across all capabilities offered by the FLASH-IANUS platform.
GROUP I	
1. Explain what are the key business goals for the exploitation of this result.	
Along with the direct benefit from royalties in the first 5 years after deployment, Cosmos Thrace will benefit from the industry insights during the project which is expected to bring new business. In addition, we expect that the new algorithms and exploration of different approaches will provide tools for other customer projects. From a marketing point of view, FLASH will provide us with a platform to gain visibility in several countries in EU and all industries that apply laser technologies.	
2. Considering the current markets where your organisation operates, refer in which the FLASH results will be exploited:	
EU and the UK, Switzerland, Norway	
3. For the above markets, fill in the following table. <i>For accuracy, please provide data sources for all topics.</i>	
3.1 Geographic characteristics	Developed markets in Western Europe
3.2 Industrial sector/application	Manufacturing, Medical, Construction
3.3 Customer profile	Medium and large companies with products requiring the application of ML algorithms to determine machine and/or materials properties
3.4 Potential Market Size	TBD
3.5 Existing Competing Technologies	TBD
3.6 Foreseen sales numbers after 5 years after market entry	TBD
3.7 Exploitation strategy/roadmap	Directly with B2B customers looking for innovative approach in their current production.
3.8 Penetration strategy	TBD
4. Detail the costs associated with the exploitation of results. <i>Provide absolute numbers per sale, or accumulated over 5 years, considering sales numbers.</i>	
4.1. Direct Costs	TBD
4.2. Indirect Costs	TBD

GROUP II		
1. Besides the potential commercial exploitation of the FLASH result, consider the categories below and answer when possible:		
	Yes	No



1.1. Can this project result lead to an increase in your organisation's employees' number?	Yes	
1.1.1. Number of potential new employees, after 5 years	10	
1.1.2. Profile of the new employees <i>White and/or blue collar, detailing the job function</i>	Data scientists; BI consultants	
2. Will your organisation benefit from the FLASH results in terms of:		
	Yes	No
	If yes, please detail:	
2.1. Innovation capability		No
2.2. Sustainability		No
2.3. Growth	Yes	
2.4. Product value chain improvement		No
3. Will you engage with other project partners to exploit the results?		
Yes		
4. How have you identified your market, its size, and characteristics?		
TBD		
5. Will you seek certification for this result (e.g. CE marking)? Please describe why.		
No, we are developing an algorithm, not a product		
6. Please describe the expected difficulties in exploiting the FLASH results:		
6.1. Necessary steps to begin exploitation	The algorithm may not apply to other use cases as expected. For some potential applications, agreements need to be made with some of the other partners in the project.	
6.2. Exploitation strategy not yet defined	TBD	
6.3. Internal challenges	As a specialised service company, we may not have the sales and marketing capabilities to exploit the FLASH results ourselves.	
6.4. Other	-	
7. Please describe any contingency plans to be put in place to mitigate exploitation risks:		
We will develop IP protection strategy during the project. It may include protecting the critical parts of the algorithm in secured cloud area, not allowing reverse-engineering.		
8. To ensure the exploitation of results, what are the funding needs for your organization?		
Cosmos intends to continue the exploitation of the algorithms regarding the project. At this point, we believe we'll need at least 120k EUR annually to continue the exploitation.		
9. How will you obtain this funding? Internal funding? National or Regional funding? Other European project proposals? Other?		
We plan for 50% from commercial activities and 50% from European project proposals.		



GROUP III		
Regarding the implementation of the technology/machine in your own company.		
1. Please fill out the SWOT analysis, with 1-5 points per category, considering the goal of exploiting the project results:		
Strengths		Weaknesses
-		-
Opportunities		Threats
-		-
2. Please fill out the PEST analysis:		
Political		Economic
-		-
Social		Technological
-		-
3. What will be the financial benefits to your company?		
Royalties; New business with the developed technology; New business from partnerships and brand		
4. Will your company benefit from resource-saving (less scrap)?		
N/A		
5. Regarding the implementation of the technology/machine in the end-users, please describe:		
Benefits	-	
Risks	-	
Difficulties	-	
Barriers	-	



Exploitation data collection form – 3Drivers

Identification
Partner's Name
3Drivers

Project Result Designation (the result from your organization)	LCA data integration in decision making tool for the FLASH system and outcomes [3DR]
Project Result Description	The decision-making tool will integrate environmental and financial impact indicators to make decisions of using the laser system or not, considering the process development, modelling, and metrology parameters.
GROUP I	
1. Explain what are the key business goals for the exploitation of this result.	
Complement LCA-Cad Tool being developed in Syntecs Project with further datasets. e.g.: sales increase for existing products, new markets and clients, cost reduction, etc.	
2. Considering the current markets where your organisation operates, refer in which the FLASH results will be exploited:	
3drivers is an environmental consultancy expert on LCA. The decision-making tool will help to set in place a data management system for data integration to minimise uncertainty and quality of the data and enable manufacturers utilising laser technology to make informed decisions about environmental impacts.	
3. For the above markets, fill in the following table. <i>For accuracy, please provide data sources for all topics.</i>	
3.1 Geographic characteristics	Europe
3.2 Industrial sector/application	Automotive, Medical, Electronics, (any manufacturing sector using laser technology.
3.3 Customer profile	Other companies
3.4 Potential Market Size	-
3.5 Existing Competing Technologies	Other LCA decision tools / software
3.6 Foreseen sales numbers after 5 years after market entry	-
3.7 Exploitation strategy/roadmap	Direct sales to customers, service providers using the project result, or both.
3.8 Penetration strategy	Offering to existing clients
4. Detail the costs associated with the exploitation of results. <i>Provide absolute numbers per sale, or accumulated over 5 years, considering sales numbers.</i>	
4.1. Direct Costs	-
4.2. Indirect Costs	-

GROUP II		
1. Besides the potential commercial exploitation of the FLASH result, consider the categories below and answer when possible:		
1.1. Can this project result lead to an increase in your organisation's employees' number?	Yes	No
	X	
1.1.1. Number of potential new employees, after 5 years	1	



1.1.2. Profile of the new employees <i>White and/or blue collar, detailing the job function</i>	LCA Expert		
2. Will your organisation benefit from the FLASH results in terms of:			
	Yes	No	If yes, please detail:
2.1. Innovation capability			
2.2. Sustainability			
2.3. Growth	X		This will result in a new business area, as we will be offering a new service
2.4. Product value chain improvement			
3. Will you engage with other project partners to exploit the results?			
NO			
4. How have you identified your market, its size, and characteristics?			
Not yet			
5. Will you seek certification for this result (e.g. CE marking)? Please describe why.			
NA			
6. Please describe the expected difficulties in exploiting the FLASH results:			
6.1. Necessary steps to begin exploitation	-		
6.2. Exploitation strategy not yet defined	-		
6.3. Internal challenges	-		
6.4. Other	-		
7. Please describe any contingency plans to be put in place to mitigate exploitation risks:			
-			
8. To ensure the exploitation of results, what are the funding needs for your organization?			
-			
9. How will you obtain this funding? Internal funding? National or Regional funding? Other European project proposals? Other?			
-			

GROUP III		
Regarding the implementation of the technology/machine in your own company.		
1. Please fill out the SWOT analysis, with 1-5 points per category, considering the goal of exploiting the project results:		
Strengths		Weaknesses



-		-
O pportunities		T hreats
-		-
2. Please fill out the PEST analysis:		
P olitical		E conomic
-		-
S ocial		T echnological
-		-
3. What will be the financial benefits to your company?		
-		
4. Will your company benefit from resource-saving (less scrap)?		
-		
5. Regarding the implementation of the technology/machine in the end-users, please describe:		
Benefits	-	
Risks	-	
Difficulties	-	
Barriers	-	



Exploitation data collection form – IMA Automation ATOP

Identification
Partner's Name
IMA Automation ATOP

Project Result Designation (the result from your organization)	-
Project Result Description	Laser-based process for copper hairpin stripping and welding
GROUP I	
1. Explain what are the key business goals for the exploitation of this result.	
Increase the competitiveness of ATOP's technological offer for customers	
2. Considering the current markets where your organisation operates, refer in which the FLASH results will be exploited:	
Hairpin motors production systems	
3. For the above markets, fill in the following table. <i>For accuracy, please provide data sources for all topics.</i>	
3.1 Geographic characteristics	Global
3.2 Industrial sector/application	Automotive
3.3 Customer profile	Tier 1, tier 2 and OEM (automotive)
3.4 Potential Market Size	1BN€/year
3.5 Existing Competing Technologies	For welding: For stripping: mechanical stripping, CO2 laser
3.6 Foreseen sales numbers after 5 years after market entry	50MLN€/year
3.7 Exploitation strategy/roadmap	The solution will be integrated into ATOP's offer of full manufacturing lines to produce hairpin motor stators
3.8 Penetration strategy	Direct sales network (global)
4. Detail the costs associated with the exploitation of results. <i>Provide absolute numbers per sale, or accumulated over 5 years, considering sales numbers.</i>	
4.1. Direct Costs	N/A
4.2. Indirect Costs	N/A

GROUP II		
1. Besides the potential commercial exploitation of the FLASH result, consider the categories below and answer when possible:		
1.1. Can this project result lead to an increase in your organisation's employees' number?	Yes	No
	x	
1.1.1. Number of potential new employees, after 5 years	5	
1.1.2. Profile of the new employees <i>White and/or blue collar, detailing the job function</i>	Mechanical designers (2), system assemblers (2), salesperson (1)	



2. Will your organisation benefit from the FLASH results in terms of:			
	Yes	No	If yes, please detail:
2.1. Innovation capability	x		Capacity to integrate innovative technology into existing products
2.2. Sustainability		x	(more sustainable for customers perhaps, not ATOP)
2.3. Growth	x		See the expected sales figures in the previous section
2.4. Product value chain improvement		x	
3. Will you engage with other project partners to exploit the results?			
Yes, PRIMA			
4. How have you identified your market, its size, and characteristics?			
5. Will you seek certification for this result (e.g. CE marking)? Please describe why.			
Normally suppliers provide certified components and ATOP assembles, thus acquiring CE marking through the certification of the supplied parts			
6. Please describe the expected difficulties in exploiting the FLASH results:			
6.1. Necessary steps to begin exploitation	Need to validate the process at the customer site		
6.2. Exploitation strategy not yet defined	The solution will be integrated into ATOP's offer of full manufacturing lines to produce hairpin motor stators		
6.3. Internal challenges			
6.4. Other	Customers not ready to implement innovation + high investment cost		
7. Please describe any contingency plans to be put in place to mitigate exploitation risks:			
-			
8. To ensure the exploitation of results, what are the funding needs for your organization?			
-			
9. How will you obtain this funding? Internal funding? National or Regional funding? Other European project proposals? Other?			
-			

GROUP III	
Regarding the implementation of the technology/machine in your own company.	
1. Please fill out the SWOT analysis, with 1-5 points per category, considering the goal of exploiting the project results:	
Strengths	Weaknesses
• More precise machines, with less scrap • Faster production • More energy efficient machines	• Need to overcome resistance from customers (mechanical processes are more known) • The new machines will be more expensive



Opportunities		Threats	
Price reduction after market uptake		-	
2. Please fill out the PEST analysis:			
Political		Economic	
-		-	
Social		Technological	
-		-	
3. What will be the financial benefits to your company?			
-			
4. Will your company benefit from resource-saving (less scrap)?			
-			
5. Regarding the implementation of the technology/machine in the end-users, please describe:			
Benefits	-		
Risks	-		
Difficulties	-		
Barriers	-		



Exploitation data collection form – MTC

Identification
Partner's Name
Manufacturing Technology Centre (MTC)

Project Result Designation (the result from your organization)	1. Background know-how for laser processing (cutting, drilling, welding and surfacing) various end-user cases. 2. Database of various laser process parameters and outcomes for training of machine learning. 3. High-fidelity multi-physics simulation models, representative of the end-use case laser process applications. 4. Integration of experimental digital metrology data into simulation models for accurate analysis of laser processing.
---	---

Project Result Description	The MTC's key result in the project is the development of know-how, data, and processes (simulation and experimental) to easily investigate, optimise and implement various laser-based manufacturing techniques (cutting, drilling, surfacing, and joining). The MTC will develop accurate simulation techniques that reduce the requirement for expansive experimental processing.
----------------------------	--

GROUP I

1. Explain what are the key business goals for the exploitation of this result.	
To increase current and acquire new capabilities in laser-related manufacturing processing and simulation.	
2. Considering the current markets where your organisation operates, refer in which the FLASH results will be exploited:	
All markets which require various laser-based manufacturing processes. All markets which benefit from the deployment of high-fidelity multi-physics simulation models.	
3. For the above markets, fill in the following table. <i>For accuracy, please provide data sources for all topics.</i>	
3.1 Geographic characteristics	Global, focus on UK and E.U.
3.2 Industrial sector/application	Aerospace, automotive, automation, power & energy, tooling, medical and electronics.
3.3 Customer profile	All manufacturers at various levels of the value chain in all industries that require laser manufacturing processes. Examples of these are, cutting and drilling jet engine and aircraft components, welding automotive body panels, surface texturing and laser cleaning of medical devices.
3.4 Potential Market Size	The global industrial laser market size was valued at USD 1.64 billion in 2018 and is projected to reach USD 9.00 billion by 2032, exhibiting a CAGR of 11.9% during the forecast period.
3.5 Existing Competing Technologies	Laser cutting, drilling, water jet-guided laser machining, surface texturing, cleaning, and welding
3.6 Foreseen sales numbers after 5 years after market entry	N/A
3.7 Exploitation strategy/roadmap	FLASH results are published and disseminated at global conferences and workshops



3.8 Penetration strategy	Use FLASH consortium members and industrial members of the MTC.
4. Detail the costs associated with the exploitation of results. <i>Provide absolute numbers per sale, or accumulated over 5 years, considering sales numbers.</i>	
4.1. Direct Costs	N/A
4.2. Indirect Costs	N/A

GROUP II			
1. Besides the potential commercial exploitation of the FLASH result, consider the categories below and answer when possible:			
1.1. Can this project result lead to an increase in your organisation's employees' number?	Yes	No	
	X		
1.1.1. Number of potential new employees, after 5 years	2		
1.1.2. Profile of the new employees <i>White and/or blue collar, detailing the job function</i>	White, research engineers who independently focus on the research and development of experimental laser manufacturing processes and simulation and modelling of laser-based manufacturing.		
2. Will your organisation benefit from the FLASH results in terms of:			
	Yes	No	If yes, please detail:
2.1. Innovation capability	X		The FLASH project will allow the MTC team to advance current capabilities in an array of laser-based manufacturing processes, and exposure to advanced laser and artificial intelligence technologies.
2.2. Sustainability	X		The FLASH project will allow the MTC to enhance its capabilities in laser manufacturing process optimisation by exploiting the simulation and AI capabilities generated by the project. This will lead to a direct reduction in the need for expansive experimental process development, reducing laser system energy consumption and material usage.
2.3. Growth	X		Dissemination material from FLASH will allow the MTC to demonstrate capabilities and attract new R&D partners interested in laser-based manufacturing and high-fidelity manufacturing simulations.
2.4. Product value chain improvement	X		AI and simulation techniques developed in the project will reduce the time spent on process development, reducing the cost of R&D and expediting the proliferation of laser-based manufacturing across the UK and global value chain/.
3. Will you engage with other project partners to exploit the results?			
Yes, the MTC will engage with other technology partners and end-use cases.			
4. How have you identified your market, its size, and characteristics?			
N/A			
5. Will you seek certification for this result (e.g. CE marking)? Please describe why.			
N/A			



6. Please describe the expected difficulties in exploiting the FLASH results:	
6.1. Necessary steps to begin exploitation	Completion of the process development phase of the project.
6.2. Exploitation strategy not yet defined	The general public, experts in the field and associated members of the MTC. This will be done through internal and external workshops and conferences. Results will be published in peer-reviewed journals and industrial application articles.
6.3. Internal challenges	N/A
6.4. Other	N/A
7. Please describe any contingency plans to be put in place to mitigate exploitation risks:	
We will develop IP protection strategy during the project. It may include protecting the critical processing capabilities for various processes.	
8. To ensure the exploitation of results, what are the funding needs for your organization?	
The MTC will continue to exploit the laser-based manufacturing and simulation processes. It is estimated that at least 100,000 Euros per annum will be required.	
9. How will you obtain this funding? Internal funding? National or Regional funding? Other European project proposals? Other?	
Internal funding, national (e.g. Innovate UK) and Horizon Europe project proposals.	

GROUP III			
Regarding the implementation of the technology/machine in your own company.			
1. Please fill out the SWOT analysis, with 1-5 points per category, considering the goal of exploiting the project results:			
Strengths		Weaknesses	
Better laser manufacturing processes, that require less time for parameter optimization. Removes the need for several laser systems.		A single system with multiple uses will lead to access issues and job queuing.	
Opportunities		Threats	
Flash system maximises innovations in laser processing and AI, allowing users to be at the cutting edge of laser-based manufacturing.		Resistance of manufacturers to the uptake of laser-based manufacturing.	
2. Please fill out the PEST analysis:			
Political		Economic	
The current geopolitical environment is pushing the trend of many nations to re-shore their manufacturing capabilities, creating a need to establish new advanced manufacturing facilities.		Current UK Government tax laws encourage manufacturers to purchase heavy equipment by offsetting the cost of the Capex.	
Social		Technological	
The general public is likely to push for green solutions, however, due to the current cost of living crisis most are not		The steady rise in the adoption of lasers and AI in the wider manufacturing environment.	



likely to pay for initiatives that improve green credentials.	
Wider adoption of new technology in AI will lead to the loss of numerous jobs, resulting in many requiring to retrain. Opportunity for Governments to assist the training in skilled manufacturing jobs that use advanced manufacturing systems like Flash.	
3. What will be the financial benefits to your company?	
A single system that offers multiple capabilities reduces the need for multiple CAPEX expenditures. Faster turnaround time in R&D, leading to more productivity person.	
4. Will your company benefit from resource-saving (less scrap)?	
Not directly, reduction in R&D time may improve personal productivity to allow them to carry out more tasks in a single day.	
5. Regarding the implementation of the technology/machine in the end-users, please describe:	
Benefits	A modular system capable of multiple production activities in a single machine.
Risks	Higher initial cost and risk customers will struggle to identify the full benefits of the system if they are first-time adopters of laser processing.
Difficulties	A single system shared across numerous operators could lead to bottlenecks.
Barriers	Slow adoption of laser-based manufacturing as customers struggle to move away from classical manufacturing methods. High maintenance bill of the system due to the complexity. High chance of issues due to the wider range of interconnected systems.



Exploitation data collection form – Synova

Identification	
Partner's Name	
Synova	

Project Result Designation (the result from your organization)	2 green laser systems in a single Laser Micro-Jet optical applied to thick material processing. Including sensor and fiber coupling module adapted to 2 other laser processing technologies other than the LMJ.
Project Result Description	Synova's key result in the project is the production of a more versatile version of both the water jet-guided laser technology and the synova FCM and sensor suite, that can be commercialized beyond the laser micro-jet technology.

GROUP I	
1. Explain what are the key business goals for the exploitation of this result.	
• To acquire new customers who are laser machine-manufacturers or laser-machine users not based on the Laser Micro-Jet technology for the fiber coupling module and sensor suite. • To create an interchangeable and easier to integrate modular LMJ-integration package for customers, thus increasing the OEM customer base for Synova's core technology.	
2. Considering the current markets where your organisation operates, refer in which the FLASH results will be exploited:	
• Medical device manufacturing. • Aerospace manufacturing.	
3. For the above markets, fill in the following table. <i>For accuracy, please provide data sources for all topics.</i>	
3.1 Geographic characteristics	Global, focus on E.U., North and South America.
3.2 Industrial sector/application	Medical device manufacturing. Aerospace component manufacturing.
3.3 Customer profile	Implant and prosthesis manufacturer. Jet engine component manufacturer. Tier 1. Highly verticalized.
3.4 Potential Market Size	The Global Medical Implant Market Size was Valued at USD 110.25 Billion in 2023 and the Worldwide Medical Implant Market Size is Expected to Reach USD 214.76 Billion by 2033, according to a research report published by Spherical Insights & Consulting. Aircraft Engine Market size was valued at USD 49.01 billion in 2019 and is poised to grow from USD 54.34 billion in 2023 to USD 137.54 billion by 2031, growing at a CAGR of 10.87% in the forecast period (2024-2031). According to Skyquest Technology
3.5 Existing Competing Technologies	For medical devices: laser cutting, milling, EDM, grinding.



	For aerospace: laser cutting, milling, EDM and grinding.
3.6 Foreseen sales numbers after 5 years after market entry	266 FLASH-IANUS units sold by 2032 (880 kEUR / unit) 20 FCM units sold/year by 2032 30 FLASH-LMJ-ip kits sold/year by 2032
3.7 Exploitation strategy/roadmap	Direct B2B sales. FLASH results published. Keynote customers in each sector with limited exclusivity avoiding non-compete challenges.
3.8 Penetration strategy	Use of existing customer base as first adopters.
4. Detail the costs associated with the exploitation of results. <i>Provide absolute numbers per sale, or accumulated over 5 years, considering sales numbers.</i>	
4.1. Direct Costs	1 Million EUR for industrialization and production
4.2. Indirect Costs	500 kEUR for marketing and sales

GROUP II			
1. Besides the potential commercial exploitation of the FLASH result, consider the categories below and answer when possible:			
1.1. Can this project result lead to an increase in your organisation's employees' number?	Yes	No	
	X		
1.1.1. Number of potential new employees, after 5 years	5		
1.1.2. Profile of the new employees <i>White and/or blue collar, detailing the job function</i>	2 production technicians, 1 product manager, 1 sales rep, 1 service engineer		
2. Will your organisation benefit from the FLASH results in terms of:			
	Yes	No	If yes, please detail:
2.1. Innovation capability	x		Capacity to integrate an innovative technology into existing products
2.2. Sustainability		x	(more sustainable for customers perhaps, not Synova)
2.3. Growth	x		See expected sales figures in previous section
2.4. Product value chain improvement	x		More modular system and simplified product line
3. Will you engage with other project partners to exploit the results?			
Yes, PRIMA, Cailabs, The MTC			
4. How have you identified your market, its size, and characteristics?			
Internal knowledge, experience and basic desk research.			
5. Will you seek certification for this result (e.g. CE marking)? Please describe why.			
Normally suppliers provide certified components, thus acquiring CE marking through the certification of the supplied parts. Synova will seek CE marking.			
6. Please describe the expected difficulties in exploiting the FLASH results:			



6.1. Necessary steps to begin exploitation	Validation of the system in practice and in comparison with other laser technologies.
6.2. Exploitation strategy not yet defined	Still unclear what new can be done to exploit the result.
6.3. Internal challenges	Product challenge: FLASH cannibalizes more lucrative sales for Synova.
6.4. Other	Change in the trend for Hybrid Manufacturing. Industry moves back to simpler technologies.
7. Please describe any contingency plans to be put in place to mitigate exploitation risks:	
The FLASH system as developed by Synova is already made of technological bricks that can be sold separately on existing applications and potential customers. The sales manager at Synova will establish a new sales strategy. The target markets are limited enough that existing Synova sales should not be negatively impacted. Stay aware of the industry's needs.	
8. To ensure the exploitation of results, what are the funding needs for your organization?	
Already covered by the Swiss funding for the project.	
9. How will you obtain this funding? Internal funding? National or Regional funding? Other European project proposals? Other?	
See 8.	

GROUP III

Regarding the implementation of the technology/machine in your own company.

1. Please fill out the **SWOT** analysis, with 1-5 points per category, considering the goal of exploiting the project results:

Strengths		Weaknesses
• More precise machines, with less scrap • Faster production • More energy efficient machines • Modular offer stabilizes sales cycles		• Need to overcome resistance from customers (mechanical processes are more known) • The new machines will be more expensive • The new machine will be more complex
Opportunities		Threats
• The ESG reporting and stronger emphasis on manufacturing efficiency are coming online in 2025-2028. • The ageing of the population will guarantee the need for more and cheaper medical implants. • The commercial aviation industry needs to reduce carbon emissions.		• Complete loss of industrial manufacturing in the EU and Americas. • Industry trend towards hybrid manufacturing not materializing into commercializing opportunity. • New hybrid technology coming online. • Commercial aviation moves away from jet engines faster than FLASH can penetrate the market.

2. Please fill out the **PEST** analysis:



Political		Economic	
The current political trend is to reshore productions. The ESG laws should work in favor of the project goals. A change in leadership towards more closed borders may be problematic for the FLASH system (consortium-based).		The economy may enter a recession which would make the sale of CapEx heavy equipment problematic. There may be a shift towards cost reduction by optimizing and refurbishing existing industrial equipment. The general ageing population may put pressure on tax allocation away from innovation incentives that could facilitate the sale of new FLASH systems.	
Social		Technological	
The social trend tends to favour energy efficiency and reduction of the number of capital assets to manufacture a given good. Lot Size 1 is becoming preferable to mass production. The customers in that industry will be more environmentally conscious of education, beliefs and regulations. A total loss of the aviation industry could be pushed on by society.		The technological trend towards laser manufacturing of everything seems to hold true. More energy-efficient laser systems are to be considered. A more cost-efficient or highly energy-efficient manufacturing technology may supersede the need for the FLASH system.	
3. What will be the financial benefits to your company?			
Sales of FLASH-IANUS have induced sales for Synova. FCM and Sensor sales are a new revenue stream.			
4. Will your company benefit from resource-saving (less scrap)?			
Not directly. However, resource-saving means higher margins could be applied.			
5. Regarding the implementation of the technology/machine in the end-users, please describe:			
Benefits	Fewer actual machines, smaller factories, and more modular systems make production easier: the same system for different operations.		
Risks	More expensive system. Higher barrier to adoption.		
Difficulties	Training of personnel on one laser process is hard enough. Training on a triple and multi-functional system could prove challenging. Integrating the single Prima system can be prohibited by customer needs for standard digital infrastructures.		
Barriers	Costs. Single supplier. Complexity. Existing machines are there for 20 more years potentially.		



Exploitation data collection form – ROBUST AO GmbH

Identification
Partner's Name
ROBUST AO GmbH

Project Result Designation (the result from your organization)	
Project Result Description	Fully integrated Z-axis for laser material processing (e.g. welding, cutting) in the beam delivery unit of the FLASH machine.
GROUP I	
1. Explain what are the key business goals for the exploitation of this result.	
1. Find new markets in the field of laser welding and cutting (probably AM as well) 2. Find new customer that needs our technology	
2. Considering the current markets where your organisation operates, refer in which the FLASH results will be exploited:	
Laser cutting	
3. For the above markets, fill in the following table. <i>For accuracy, please provide data sources for all topics.</i>	
3.1 Geographic characteristics	Global
3.2 Industrial sector/application	Laser based manufacturing processes
3.3 Customer profile	Laser machine builder
3.4 Potential Market Size	Global 5.59BN \$
3.5 Existing Competing Technologies	Scanlab
3.6 Foreseen sales numbers after 5 years after market entry	-
3.7 Exploitation strategy/roadmap	We will make sure to communicate the commercial availability of our technology integrated into the FLASH machine for more flexibility and efficiency during laser material processes.
3.8 Penetration strategy	-
4. Detail the costs associated with the exploitation of results. <i>Provide absolute numbers per sale, or accumulated over 5 years, considering sales numbers.</i>	
4.1. Direct Costs	-
4.2. Indirect Costs	-

GROUP II
1. Besides the potential commercial exploitation of the FLASH result, consider the categories below and answer when possible:



1.1. Can this project result lead to an increase in your organisation's employees' number?	Yes		No
	Yes, we expect some increase in employees based on our assumption that we can sell more Zwobbel or Zwobbel_DBS. We hope to generate 1-2 new positions.		
1.1.1. Number of potential new employees, after 5 years	2-4 new employees		
1.1.2. Profile of the new employees <i>White and/or blue collar, detailing the job function</i>	• 1-2 for workshop assembly and test of the Zwobbel mirror • 1 for sales • 1 management and internal organisation		
2. Will your organisation benefit from the FLASH results in terms of:			
	Yes	No	If yes, please detail:
2.1. Innovation capability	x		Yes, we expect the development of a new product based on the new wavelength and applications. We also expect some outcome from the joint test laser beam shaping approaches (Cailabs) for additive manufacturing, welding and cutting.
2.2. Sustainability	x		Dynamic beam shaping technology is design for sustainability as we increase manufacturing quality. Doing so reduces rework and users of our technology should need less machines and personal for reworking. The technology may also help to speed-up processes. Thus, the machine output is increases with constant energy input.
2.3. Growth	x		Our target is to get better market penetration in France, Spain, UK and Italy thanks to collaboration with our project mates.
2.4. Product value chain improvement	x		We expect reduced costs for ROBUST AO as we may have easier access to potential customers based on our project partners. Our customers gain a pre-tested product with increased productivity.
3. Will you engage with other project partners to exploit the results?			
We plan to engage with CAILABS and are currently in discussion with other project partners.			
4. How have you identified your market, its size, and characteristics?			
We analysed publications and market research studies. And we fully agree to the identified markets in our proposal.			
5. Will you seek certification for this result (e.g. CE marking)? Please describe why.			
To sell our products, we need CE certifications. In the case of a successful project, we plan CE marking when we reach the needed TRL level of 9 and 10. However, CE marking is not in the frame of this project.			
6. Please describe the expected difficulties in exploiting the FLASH results:			
6.1. Necessary steps to begin exploitation	The product may not be market-ready, further technical development is needed such as other mechanical or		



	electrical interfaces. We need also proper product documentation.
6.2. Exploitation strategy not yet defined	We will use the project to develop an exploitation strategy and might be able to comment this in a later stage.
6.3. Internal challenges	Currently, we do not face internal challenges.
6.4. Other	NA
7. Please describe any contingency plans to be put in place to mitigate exploitation risks:	
Regular meetings with project partners and internally to check the fulfilment of our working plan. Getting in contact with potential partners and discussing the potential outcome of the activity.	
8. To ensure the exploitation of results, what are the funding needs for your organization?	
We need to be able to visit and display at relevant trade fairs and conferences.	
9. How will you obtain this funding? Internal funding? National or Regional funding? Other European project proposals? Other?	
We will define a strategy for that one year before the end of the activity as we can specify better the need that we have and see the potential funding landscape.	

GROUP III	
Regarding the implementation of the technology/machine in your own company.	
1. Please fill out the SWOT analysis, with 1-5 points per category, considering the goal of exploiting the project results:	
Strengths	Weaknesses
Zwobbel technology with clear USP	Still some technical challenges (optical quality and stability) that need to be understood and counteracted.
Opportunities	Threats
We will learn about new potential applications in an international landscape We will learn about innovation in other international companies of different statuses (small SMU, research institutes,..)	Build a machine that won't be needed or is without customers as it is too expensive. We do not have a clear vision of where such a universal machine might be needed. We have too little time to generate good results with our new machines/capabilities /technologies
2. Please fill out the PEST analysis:	
Political	Economic



Unsure how German companies may deliver their products to China (as China is the fastest growing market worldwide) We cannot find skilled personnel for the application developments		We do not know how to deal with ASIAN products that come into EUROPE well below the price that is feasible for European companies. Use situation in Germany and people are unsure about their future and therefore invest less.	
Social		Technological	
Too little communication between the teams.		Is the idea of a universal machine good enough?	
3. What will be the financial benefits to your company?			
We will open up new markets, and foreign companies will be used to our technology			
4. Will your company benefit from resource-saving (less scrap)?			
Not really. And we have the impression that manufacturing quality increase is far more important than scrap saving or energy saving.			
5. Regarding the implementation of the technology/machine in the end-users, please describe:			
Benefits	One machine fits all your needs, higher productivity and better machining quality		
Risks	The machine is not stable and too complicated to operate		
Difficulties	One needs one good salesperson/team with very good product explanation capability.		
Barriers	No one needs such a machine. No problems are there to solve.		



Exploitation data collection form – AIMEN

Identification
Partner's Name
AIMEN

Project Result Designation (the result from your organization)	Develop a universal in-process monitoring solution , based on acoustic and optical sensors to deliver a stable manufacturing process suitable for <u>unsupervised 24/7</u> processing in industrial environments.
Project Result Description	In-process monitoring and control module based on a second-generation optical breakthrough and intensity detection sensor (KER-4a), and acoustic monitoring sensor (KER-4b).

GROUP I

1. Explain what are the key business goals for the exploitation of this result.	
Increase sales and potential customers by developing versatile tool customizable to current existing industrial products.	
2. Considering the current markets where your organisation operates, refer in which the FLASH results will be exploited:	
Aerospace & Automotive	
3. For the above markets, fill in the following table. <i>For accuracy, please provide data sources for all topics.</i>	
3.1 Geographic characteristics	Worldwide, mainly in Western countries.
3.2 Industrial sector/application	Aerospace: Laser cutting, drilling, machining and welding for components and assemblies. Automotive: Laser welding, cleaning, marking, and cutting for components and assemblies.
3.3 Customer profile	Option A) <i>Main providers</i> , e.g. Synova. Option B) <i>Final users</i> mainly from Aerospace (e.g. Rolls Royce, Airbus, GE Aviation, Pratt & Whitney, Honeywell Aerospace, CFM International, Pyromeral, Avio, Safran, MTU, Dassault, SAAB, BAE and Boeing) and Automotive sectors (e.g. TOFAS, ATOP, Teknorot, Marelli, Tenneco, Robert Bosch GmbH, ThyssenKrupp AG, Faurecia).
3.4 Potential Market Size	-
3.5 Existing Competing Technologies	No existing in-process sensor is suitable for monitoring of the full range of processes. The combination of SYN's optical sensor with AIMEN's acoustic microphone sensing appears to be unique.
3.6 Foreseen sales numbers after 5 years after market entry	30 FLASH-LMJ-IP kits sold/year by 2032 (licensed via SYN). 10k€/unit (30% of SYN direct costs). Expected revenues 30.000k€/year.
3.7 Exploitation strategy/roadmap	Royalties. Service providers using the project result.



3.8 Penetration strategy	Existing customers as first adopters
4. Detail the costs associated with the exploitation of results. <i>Provide absolute numbers per sale, or accumulated over 5 years, considering sales numbers.</i>	
4.1. Direct Costs	300k€
4.2. Indirect Costs	150k€

GROUP II			
1. Besides the potential commercial exploitation of the FLASH result, consider the categories below and answer when possible:			
1.1. Can this project result lead to an increase in your organisation's employees' number?	Yes	No	
	X		
1.1.1. Number of potential new employees, after 5 years	NA		
1.1.2. Profile of the new employees <i>White and/or blue collar, detailing the job function</i>	Optical/acoustical technicians and engineers. Sales manager.		
2. Will your organisation benefit from the FLASH results in terms of:			
	Yes	No	If yes, please detail:
2.1. Innovation capability	x		Capacity to integrate an innovative technology into existing and new products
2.2. Sustainability		x	
2.3. Growth	x		See expected sales figures in previous section
2.4. Product value chain improvement		x	
3. Will you engage with other project partners to exploit the results?			
Yes, SYNOVA			
4. How have you identified your market, its size, and characteristics?			
Yes. From previous R&D projects			
5. Will you seek certification for this result (e.g. CE marking)? Please describe why.			
NA			
6. Please describe the expected difficulties in exploiting the FLASH results:			
6.1. Necessary steps to begin exploitation	The product may not be market-ready and further technical and R&D development is needed to reach TRL9 (note FLASH monitoring tool will reach TRL7).		
6.2. Exploitation strategy not yet defined	Once TRL9 is reached it will be licensed to a third-party. e.g. Synova.		
6.3. Internal challenges	Not TRL9 reached and/or have a product not competitive enough in the market.		
6.4. Other	NA		
7. Please describe any contingency plans to be put in place to mitigate exploitation risks:			



Stay aware of the industry's needs. Establish a new sales strategy. Get new R&D funds to reach the correct readiness of the product to exploit in industrially.

8. To ensure the exploitation of results, what are the funding needs for your organization?

Innovation programmes at European, national or regional level + own resources + Productive investment loans & programmes/ soft loans

9. How will you obtain this funding? Internal funding? National or Regional funding? Other European project proposals? Other?

See 8

GROUP III		
Regarding the implementation of the technology/machine in your own company.		
1. Please fill out the SWOT analysis, with 1-5 points per category, considering the goal of exploiting the project results:		
Strengths		Weaknesses
AIMEN covers a wide range of different laser processes where the FLASH tool could be tested and validated.		The strength of our company lies in R&D rather than in sales.
Opportunities		Threats
Digitalization. Industry 5.0.		-
2. Please fill out the PEST analysis:		
Political		Economic
-		-
Social		Technological
-		-
3. What will be the financial benefits to your company?		
Royalties.		
4. Will your company benefit from resource-saving (less scrap)?		
No		
5. Regarding the implementation of the technology/machine in the end-users, please describe:		
Benefits	-	
Risks	-	
Difficulties	-	
Barriers	-	