D8.6

OPTIMAI commercialization and exploitation strategy - 1st version

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OPTIMAI

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LIST OF ABBREVIATIONS

Abbreviation	Definition
AI	Artificial Intelligence
API	Application Programming Interface
AR	Augmented Reality
B2B	Business to Business
CV	Computer Vision
DID	Decentralized Digital Identity
DLT	Distributed Ledger Technologies
DSS	Decision Support System
FTO	Freedom-to-Operate
GUI	Graphical User Interface
HCI	Human-Computer Interfaces
KER	Key Exploitable Result
ICT	Information Communication Technology
IoT	Internet of Things
IPR	Intellectual Property Rights
NESSI	Networked European Software and Service Initiative
OPC UA	Open Platform Communications United Architecture
RFID	Radio Frequency Identification
TBD	To Be Defined
TRL	Technology Readiness Level

Executive Summary

Deliverable D8.6 OPTIMAI commercialization and exploitation strategy 1st version is the first version of the OPTIMAI Exploitation Plan. Exploitation aims at ensuring that OPTIMAI becomes sustainable well after the conclusion of the research project period so as to create impact.

OPTIMAI intends to develop an industry environment that will optimize production, reducing production line scrap and production time, as well as improving the quality of the products through the use of a variety of technological solutions, such as Smart Instrumentation of sensors network at the shop floor, Metrology, Artificial Intelligence (AI), Digital Twins, Blockchain, and Decision Support via Augmented Reality (AR) interfaces. The innovative aspects: Decision Support Framework for Timely Notifications, Secure and adaptive multi-sensorial network and fog computing framework, Blockchain-enabled ecosystem for securing data exchange, Intelligent Marketplace for AI sharing and scrap re-use, Digital Twin for Simulation and Forecasting, Embedded Cybersecurity for IoT services, On-the-fly reconfiguration of production equipment allows businesses to reconsider quality management to eliminate faults, increase productivity, and reduce scrap.

The OPTIMAI exploitation strategy has been drafted and it consists of three phases: Initial Phase, Mid Phase and Final Phase where different activities are carried out. The aim of the Initial phase (M1 to M12), reported in this deliverable, is to have an initial results' definition for OPTIMAI and the setup of the structures to be used during the project lifecycle. In this phase, also each partner's Individual Exploitation commitments and intentions are drafted, and a first analysis of the joint exploitation strategies is being presented. The next steps, leveraging on the outcomes of the preliminary market analysis, will be to update the Key Exploitable Results with a focus on their market value and business potential and to consolidate the IPR Assessment and set up a concrete Exploitation Plan.

The result of the next period of activities will be reported in D8.7 OPTIMAI commercialization and exploitation strategy - 2nd version due at month 18 (June 2022)

Table of Contents

LIST OF FIGURES

LIST OF TABLES

1 Introduction

The OPTIMAI exploitation strategy is based on individual and common exploitation plans. The project partners form the value chain for exploitation and are providing their first approach to the exploitation. This includes research from the academic partners and technology transfer from the industry partners into their respective lines of business. Whilst the exploitation of the OPTIMAI results will be encouraged outside the consortium, there are internal approaches to ensure the longevity of the OPTIMAI outcomes. This involves the development of a plan that defines a roadmap for future development and support of the OPTIMAI market exploitation. To this end, partners will continue monitoring project internal advances as well as market development, and therefore will propose and possibly update the business plan.

The business plan will consider the best approach to exploit OPTIMAI results and will look beyond the current scope of the project. It will present the possibilities of advancing and developing the OPTIMAI system beyond the initial funding period.

This document defines the preliminary plans in terms of key exploitable results and IPR, as well as individual and joint exploitation opportunities. The main parts of the deliverable are the following:

- Definition of the Exploitation Framework: this describes the OPTIMAI system, its innovative aspects and the main functionalities.
- Description of the objectives and methodology followed for the implementation of the Exploitation and Business Plan
- Identification of Exploitable Results: this introduces the set of project assets, governed by the IPR structure, that have a significant value for exploitation.
- IPR Management: this defines the rules for controlling the use and exploitation of the project results and knowledge.
- Individual Exploitation Plans: this describes the exploitation activities of each partner regarding individual building blocks of the system.
- Consortium Exploitation Plans. This presents an initial analysis of a future Join Exploitation Plan presenting the different possibilities and the impact on the project and partners.

Moreover, an overview of standardization activities is provided.

2 Exploitation framework

2.1 OPTIMAI solution

OPTIMAI intends to develop an industry environment that will optimize production, reducing production line scrap and production time, as well as improving the quality of the products through the use of a variety of technological solutions, such as **Smart Instrumentation of sensors network** at the shop floor, **Metrology**, **Artificial Intelligence (AI)**, **Digital Twins**, **Blockchain**, and **Decision Support** via **Augmented Reality (AR)** interfaces. More specifically, the production line will have a multimodal sensory network for quality control, which consists of metrology sensors (laser sensors, industrial cameras, electronic microscopes, ultrasonic probes), combined with machinery sensors that monitor production parameters (temperature, vibrations etc.) based on pilots' needs. A middleware layer will coordinate the sensorial data under a common framework, allowing for the collection of timestamped, registered, and semantically fused data as well as two-way communication for actuation and data collecting. A cybersecurity module incorporated in the middleware will protect the network from cyber-threats, and a Blockchain API will be implemented to enable traceability and validation of any data transaction within the OPTIMAI system regarding measurements data collection, requests for machinery reconfiguration or health check. A series of AI approaches for zero defect manufacturing will be established that will feed the different OPTIMAI modules. AI techniques will be used for defect detection, the analysis of multisensorial quality inspection data and the identification of faults' causes upstream in the production process. In conjunction with AI, digital twinning technology will be employed for the virtualization and simulation of the production process including sensors and manufactured parts, to enable undisruptive and optimized production planning. AI deep models will be used to automatically pinpoint anomalies on sensory signals regarding defects on manufactured products or defective operation of production equipment. Finally, a context-aware AR environment will be used to support optimised decision making for shop floor operators to allow. Human-Computer Interfaces (HCI) will be created based on Computer Vision (CV) methods and AI to understand operator intents. AI models will provide overlay information and concrete actions for industrial optimization on AR glasses for the operator to quickly proceed with actuation or reconfiguration of production parameters. Finally, for profiling, indexing, and repurposing damaged parts, as well as exchanging AI models for quality inspection, an intelligent marketplace will be established.

The OPTIMAI solution will be exploited under a concrete OPTIMAI exploitation framework defined in this deliverable, which will be updated later on the project (D8.6 2nd version) to reflect better the needs of the market and the consortium, as well as to ensure that continues to serve the OPTIMAI objectives. OPTIMAI consortium will expand its current catalogue of provided services and products by adding solutions developed within the project. In the context of reaching industrial parties, technological partners will expand their portfolio of technological solutions on their expertise, while service providers will update and expand their services. End-users will optimize their production lines by reducing their scrap, production time and cost, and

increase the quality of their products with the capability to increase their share in market. All partners will empower their capability on covering industry 4.0 needs and where they stand in industrial market. Finally, using their know-how acquired and experience from OPTIMAI project, all partners will be able to establish continuous collaborations within the consortium and also approach new potential partners to enable their participation in future proposals based on similar topics to OPTIMAI.

This section describes in detail the exploitable innovative aspects of the OPTIMAI solution; how these solutions consist of its main functionalities; as well as its impacts in the work programme, the market, the society and the environment.

2.1.1 Innovative aspects

In this section the exploitable innovative aspects of the OPTIMAI solution are presented.

Decision Support Framework for Timely Notifications: OPTIMAI will develop and deploy an integrated decision support framework that is connected to AI-based solutions, providing on-time notifications to the operators regarding identified or potential defects. In detail, intelligent monitoring and control of production, smart, secure, and traceable data collection based on a distributed ledger, advanced interaction mechanisms for rapid and efficient equipment reconfiguration, and optimal production planning via virtualization and AI, the Decision Support Framework will provide decisions for zero-defect manufacturing. The Decision Support Framework will allow stakeholders to be informed about the current problematic situation and make appropriate decisions regarding the quality control and inspection actions that need to be taken to address the problems. The best decisions will be made using a multi-objective optimization framework that considers variables including machine performance and failure rates, as well as energy usage. OPTIMAI's service portfolio will contain a collection of cutting-edge methodologies and systems for quick product (re)configuration, integrating the advantages of interactive augmented reality (AR) services, Decision Support Algorithms (local and high level), and modern ICT technologies (e.g., Smart Sensor Network, RFIDs, gateways, etc.). Based on the use of the network virtualization idea, digital twinning of manufacturing processes will be able to operate as a virtual prediction function orchestrator to deliver customised cognitive and predictive (fault detection, identification, and forecasting) services.

Secure and adaptive multi-sensorial network and fog computing framework: Distributed computing for industrial IoT networks can benefit from low-cost, real-time digital signal processors incorporated in generic Internet of Things (IoT) edge devices. Such an approach safeguards that a potential node failure will not result in the entire network collapsing, thus distributed computing in an IoT network provides a more fault tolerant and attack resilient network. Also, because the amount of compute work required from each device will be adjusted to their particular capabilities and available resources, common resource-constrained IoT edge devices will be able to engage in network computing. Data storage can be shared, the impact of outages can be absorbed by the network, and hostile agents will find it nearly impossible to take over the entire network.

Blockchain-enabled ecosystem for securing data exchange: In a blockchain network, all key system processes will be stored as immutable and verifiable transactions. Smart contracts will be used to automate several production line processes, an access control mechanism will be implemented to prevent unauthorized users from performing critical system operations, and blockchain-based data integrity verification mechanisms will be used to ensure the integrity of the software and firmware versions deployed. Blockchain will provide a decentralized solution for real-time validity and traceability within a production process. Blockchain allows for the secure integration of Web/Cloud Platforms with a private Ethereum Blockchain, with the objective of facilitating efficient permission management for Platform users' data. With OPTIMAI, the blockchain may be utilized to provide an immutable record of AI system choices and actions, resulting in a more trustworthy AI system.

Intelligent Marketplace for AI sharing and scrap re-use: A marketplace will be developed to bring together interested parties who wish to sell or buy scrap or AI models. The marketplace will boost the distribution of AI models between businesses for common activities such as surface inspection, production techniques deficiencies detection (e.g., injection moulding) etc. The intelligence of the system lies, in an agent-based brokering module that will use syntactic and semantic matching (both taxonomy-based and feature-based) in terms of manufacturing capabilities to identify the best potential supplier to fulfil an AI service or rejected part request, by an industrial business.

Digital Twin for Simulation and Forecasting: Simulation and forecasting of industrial processes, machinery, and production lines using a digital twin. The virtual twin will hold all relevant data for a manufacturing process and, when combined with AI prediction models, will provide a simulation testbed for production planning. AI-enabled digital twins will be developed to digitize and duplicate the behaviour and properties of manufactured parts, production processes, and sensors. The extensive analysis and digital model creation for each process in the desired use cases will be used to achieve this multi-faceted digitization of production components. Digital twins will be combined with deep AI models to model production equipment and sensor behaviour, simulate production outcomes in consecutive manufacturing phases, and propose a method to virtualize the complete production process. AI will be trained using production equipment configuration parameters and registered (time-stamped) quality control procedures. These pairs of production parameters and quality control outcomes will be utilized to develop a cause-and-effect map that will be connected with digital twins and AI.

Embedded Cybersecurity for IoT services: OPTIMAI will address the cyber security challenges in the smart manufacturing domain by introducing an AI-powered security middlebox capable of implementing the technical security controls required to protect the assets (hardware and software) that reside in or interact with an industrial manufacturing facility's IoT ecosystem. The controls will be aimed at identifying, preventing, and mitigating cyber risks, regardless of their source (i.e. if it is an internal or external threat). Because there will be a need to protect both assets living at the edge (e.g. IoT sensors, AR glasses) and assets living in the virtual world (e.g. data stored in virtual servers of a private datacentre), the security middlebox will be available in

both a hardware and a virtual (software) flavour, aiming to address the operational peculiarities and security requirements of each case in the best way possible.

On-the-fly reconfiguration of production equipment: By combining a variety of AI approaches for fault detection and prediction, OPTIMAI will provide an AI-enabled quality control system. End-users will be provided with insights emerged by the system's analysis, as well as correction recommendations, via AR glasses and interfaces, addressing the human-environment interaction needs of the decision support framework for zero-defect manufacturing. To that end, OPTIMAI will research and develop an Augmented Reality framework that will use computer vision techniques to understand the operator's activities and gestures and adjust equipment parameters accordingly, allowing operators and production equipment to communicate more easily and quickly. To offer the analytical data from monitoring and inspection, AR glasses will be used to depict analysis results based on the operator's viewpoint. This augmented reality framework will also be used to superimpose found defects or malfunctions on top of parts or equipment, allowing human operators to rearrange the equipment and make more informed scraping, maintenance, and production planning decisions.

2.1.2 Main functionalities

This section described the main functionalities of the OPTIMAI system.

The Quality Control Sensor Network is a multimodal sensory network with edge-processing capabilities for improved acquisition and pre-processing to support in real-time the operators for decision making and the production line via re-configuration of the machinery parameters to optimise production and increase the quality of manufactured products. This network comprises a variety of sensors for quality control and production monitoring. Metrology sensors, such as laser sensors, industrial cameras, electronic microscopes, and ultrasonic probes, will be used in conjunction with machine sensors to monitor typical production characteristics (s (e.g., power, temperature, vibration etc.). Depending on the specifics of each pilot, different combinations of sensors will be deployed for each end user. OPTIMAI focuses on the deployment of complementary sensors to provide a complete picture of all quality-critical production phases.

The registration of measurements and actions in location (i.e., production step) and timestamps through a Middleware layer is the first step in harvesting the complementarity of the OPTIMAI's sensory network. The OPTIMAI middleware layer will integrate heterogeneous sensors into a common framework and manage data acquisition and flow to the control and analysis modules, ensuring accurate data registration in time (in terms of the manufacturing lifecycle) and space (in terms of production stage and equipment). In addition to gathering and forwarding quality inspection and production data, the middleware will include a cybersecurity module to defend the sensor network from cyber-threats. Other supported functions include the automatic control of sensor settings such as laser power, linear stages, resolution, and so on, allowing for the optimization of acquisition parameters using OPTIMAI's AI components. The middleware's online data will be saved for model retraining, and the insertion of historical data or open datasets will be possible. To make existing data more reusable, standard data formats will be established for any external data sources.

Graphical User Interfaces (GUIs) as well as Human – Computer Interaction (HCI) modules will be created based on computer vision methods and AI to understand operator intents and proceed with actuation or recalibration suggestions for quick reconfiguration of production parameters. Hence, OPTIMAI via the Augmented Reality framework will be capable to comprehend the operator's activities and gestures (with the use of Computer Vision mechanisms) and remotely manipulate the equipment, modifying its parameters accordingly, in order to facilitate and speed up the interaction between operators and production environment. The video stream from AR glasses will be used to date manufacturing phases that require manual involvement, and the operator's activities will be analysed. The results of its analysis, as well as correction recommendations, will be given to end-users via AR glasses and interfaces, completing the decision support framework for zero-defect manufacturing. The context-aware AR framework, will be able to superimpose discovered problems or malfunctions on top of parts or equipment, allowing human operators to reconfigure the equipment to optimize production.

OPTIMAI Data Repository will store and manage the system data, such as data from middleware, historical and open access data. Data fusion strategies will be researched for concurrently training AI models and exploiting the correlations between sensors while the sensorial network will be dispersed across the manufacturing line and will give diverse data. For the re-usability of the data, standard formats will be used. The built models will be able to identify upstream causes of problems by using the timestamp and registration in the production of each measurement.

All critical system operations will be logged as immutable and verifiable transactions in a Blockchain network. Smart contracts will be used to automate several processes within the production line, an access control mechanism will be implemented to prevent unauthorized users from performing critical operations on the system, and blockchain-based data integrity verification mechanisms will be used to ensure the integrity of the software and firmware versions deployed. Within an actual production line, blockchain will give a decentralized solution for real-time validity and traceability. A side chain, i.e. an external database, will be employed to store the vast number of measurements collected by the sensors. Appropriate mechanisms and smart contracts for industrial applications will be deployed to implement access control (ownership, permissions) and management for produced data through the adoption of Decentralized Digital Identities (DIDs), validation of firmware or software installed on sensors and OPTIMAI middleware, integrity of data produced and exchanged from/to the critical sensors of the production line through data logging, and immutable tracking of important system functions such as actuation signals.

OPTIMAI to save more resources, will build a marketplace where all damaged parts will be indexed and re-used for various purposes like R&D testing or reconditioning. The marketplace will keep track of a defective part's whole profile and will allow users to search for it using both text and 3D similarities allowing it to be re-used for various reasons such as machine refurbishment, re-use, and so on. Furthermore, the marketplace will allow third parties to share AI algorithms developed by OPTIMAI with third parties who want to improve their production quality by leveraging OPTIMAI's AI models for defect identification and prediction. The purpose of an intelligent marketplace will be to share AI models between industries for common tasks

such as surface inspection, using the domain adaptation concept of A and index sub-quality parts, recycling them for other uses thus reducing scrap.

AI approaches will be applied across the manufacturing process spectrum, and we can distribute them through the modules Digital Twins, Production Optimization, Smart Quality Control, and the aforementioned AR suggestion framework. In the context of optimized production planning, AI-enabled digital twins will be developed, to digitize and mimic the behaviour and attributes of produced parts, production processes, and sensors. Integrated deep AI models will be used to model production equipment and sensor behaviour, simulate production outcomes in successive manufacturing phases, and design a technique to virtualize the entire production process. In this way, it will be possible to simulate a parametric production line, which will be used for the Production Optimization, while the operator will be able to re-configure various parameters for optimal production planning. By utilizing the produced digital twins, end-users will be able to investigate the effects and results of various production parameters and thus select the best ones, taking into account factors such as avoiding production faults and downtime while also conserving resources. Smart Quality Controls will allow through the use of deep models, the automatic identification and localization defects on a manufactured part and provide predictions on upcoming defects via the analysis of recent quality control measurements from the sensory network and the use of digital twins of manufacturing processes under certain parameters for the analysis of sensory signals. OPTIMAI's deep models will be able to detect anomalies on manufactured items and on production equipment processes to locate and predict defects. Results from sensors' monitoring and defect detection will be used to overlay the needed information on AR glasses of the operator, based on the current context of operation, presenting aggregated measurements and suggestions.

2.1.3 OPTIMAI Impacts

The OPTIMAI project, with the advancement of modern digital technology, allows businesses to reconsider quality management in order to eliminate faults, increase productivity, and reduce scrap. The OPTIMAI is equipped with a number of important enabling digital technologies (such as smart sensors, machine learning, digital twins, AR, and AI) that may improve all aspects of manufacturing operations, including yield, speed, and cost. OPTIMAI will boost productivity by detecting flaws in real time and taking corrective action in real time, limiting the negative impact of malfunctions and defects. In order to do this, technologies will be developed for the rapid and (semi)-automated reconfiguration of equipment in response to quality control feedback, allowing the production line to quickly recover in the event of a deficit or fault.

OPTIMAI adheres to EU and international Industry 4.0 norms and guidelines[1,2], focusing on quality control methodologies, as it aims to improve smart manufacturing efficiency through automation and boost the sector's growth in Europe and beyond. OPTIMAI aspires to significantly affect the industrial production, facilitating businesses to improve their competitiveness and increase their market share, with increased quality of products, through

[1] https://www.europarl.europa.eu/RegData/etudes/BRIE/2015/568337/EPRS_BRI(2015)568337_EN.pdf
[2] https://www.effra.eu/factories-future

the early detection of defective manufacturing parts and the prediction of defective manufacturing processes, and their in-time mitigation via quick re-configuration of machinery. Additionally, OPTIMAI will allow businesses to quickly respond to market needs, providing quick prototyping and efficient production planning when introducing a new type of product manufacturing in the production line, through digital twins and simulation. Furthermore, OPTIMAI will increase profit margins for businesses, due to the optimization of production in terms of time and cost (increased capacity of the production line, optimized planning and simulation tested parameters transferred to the real production line, reduced production time, reduce re-configuration time with AR HCI) and resources management (reduced scraped manufacturing parts & materials via defective products reduction, re-use of scrap). The OPTIMAI will also improve resource efficiency and alleviate the pressures of resource scarcity and shortage, a case immerged during the pandemic COVID-19. OPTIMAI will play a significant role in increasing and boosting employment in Europe, demonstrating new manufacturing environments that include multimodal collaboration, enhanced human-machine interfaces, and new types of human-machine collaboration. Thus, OPTIMAI offers possibilities for operators' upskilling in the shop floor; creates more appealing high-tech working environments and makes industrial environments more attractive to the next generation of employees, engineers, and researchers.

By delivering technological solutions that enable enterprises to support high variability production and readily react to rapidly changing production orders, OPTIMAI will cut ramp-up time. This will be accomplished through production virtualization, which will allow for rapid testing and validation of new product types, as well as (semi)-automated equipment (re)configuration methods based on AI, AR, and CV. Any re-calibration that may be required in early production will be automated in real-time via quality control feedback or considerably accelerated by OPTIMAI's context aware AR framework, which will allow human operators to quickly modify a machine's configuration. At the same time, by improving manufacturing efficiency, production costs in terms of resources and time will be decreased. The OPTIMAI project will use a simulation engine to build a virtual environment that is identical to the actual machine, as well as the Digital Twins approach to monitor and anticipate the performance and state of manufacturing assets, in order to optimize production processes. By using a Digital Twin to simulate and anticipate the manufacturing process, prospective flaws and defects in the machinery can be identified, adding to the predictive maintenance process and improving cost, time, and production efficiency. OPTIMAI will develop an intelligent marketplace for the indexing and retrieval of scrap and its relevant metadata (e.g., measurements, specifications, defects, etc.) in order to facilitate its re-use and re-purposing, either from the manufacturing industry or from external sources that are connected to the marketplace, in order to manage and reuse the generated scrap. The Intelligent Marketplace for Scrap Sharing will record the whole profile of a problematic item and will offer search based on text as well as 3D similarities so that it can be re-used for various purposes Production is available 24 hours a day, seven days a week, thanks to analytics provided by DSF's innovative predictive maintenance solutions, which can forecast or avoid future problems, this allows for more accurate maintenance planning and fewer production halts. Production flaws that currently may escape quality control will be eliminated,

and their proliferation and manifestation will be minimized, thanks to smart instrumentation of the production line and the deployment of AI models.

OPTIMAI **boosts security** by offering Blockchain-based solutions. The system enables AI system operations to be monitored and human control over the system to be improved. Furthermore, by providing predictive maintenance, you can avoid emergency situations such as machine failure, which can result in accidents and other problems. OPTIMAI's Decision Support Framework can help reduce operational costs by providing predictive maintenance solutions and better planning. OPTIMAI will demonstrate and validate how delays in product delivery can be decreased by forecasting failures and improving maintenance procedures, resulting in increased equipment normal operation.

With respect to environmental impacts, OPTIMAI will facilitate sustainable manufacturing, through **production optimization**. The production planning with the use of digital twins and simulation allows factories to easier introduce new products to their production line with reduced risk. Firstly, because operators do not need to stop the production line to test the production of a new product, and secondly the new production testing process will be executed digitally in the simulation engine until the optimal setup the, allows factories to easier introduce new products to their production line with reduced risk. Additionally, through the production planning, the reconfiguration of the production line is executed by transferring the digital parameters of the simulation to the real production line, reducing errors and subsequently defective production after re-configuration. OPTIMAI reduces time and subsequently cost of the production through automation solutions and by supporting operators in early detection of defective processes and manufacturing parts, as well as their re-configuration work with provided notifications immerged from analysed data that indicate malfunctions and recommendations for decision making. Furthermore, OPTIMAI reduces scraps not only by reducing the manufacturing of defective products but also by re-using generated scraps in the Intelligent Marketplace, where all defective parts will be documented and kept so that they can be re-used for various reasons like refurbishment and re-use. Moreover, OPTIMAI provides user-friendly **knowledge management tools** and **decision support systems** for optimal decision-making of quality control and assessment techniques for manufactured products and upstream this information to prevent upcoming defects and allow the timely maintenance and repair of equipment. Finally, OPTIMAI will reduce manufacturing costs for items with the use of reusable components (>30%); reducing of result in less scrap from the testing process. Additionally, through the production planning, the reconfiguration of the production line is executed by transferring the digital parameters of the simulation to the real production line, reducing errors and subsequently defective production after re-configuration. OPTIMAI reduces time and subsequently cost of the production through automation solutions and by supporting operators in early detection of defective processes and manufacturing parts, as well as their re-configuration work with provided notifications immerged from analysed data that indicate malfunctions and recommendations for decision making. Furthermore, OPTIMAI reduces scraps not only by reducing the manufacturing of defective products but also by re-using generated scraps in the Intelligent Marketplace, where all defective parts will be documented and kept so that they can be re-used for various reasons like refurbishment and re-use. Moreover, OPTIMAI

provides user-friendly knowledge management tools and decision support systems for optimal decision-making of quality control and assessment techniques for manufactured products and upstream this information on waste and scraps from de- and remanufacturing (>40%); and will reduce de- and remanufacturing costs with the adoption of new processes (>20%).

Regarding societal Impacts, OPTIMAI is expected to create **sustainable and attractive workplaces** for Europe and establish sustainable care and responsibility for employees and citizens in supply chains. The OPTIMAI context-aware recommendations system will facilitate the operators in their everyday tasks through AR glasses, while the smart quality control with automation and the fused data visualisation tools will support them in decision making and mitigating anomalies in the production line. OPTIMAI solutions will reduce menial tasks that will be replaced by more demanding operations with human machine interactions. Thus, the project will create new types of jobs with upskilling of the existing workforce, as well as creating new tasks for future employees to pursue. Stimulating the manufacturing sector and offering high-tech, well-paid opportunities that can attract operators, engineers and researchers, will allow European industrial environments to remain competitive.

3 Exploitation Objectives and Methodology

3.1 Exploitation Objectives

According to the European Commission glossary, Exploitation is defined as "Means to make use of the results produced in an EU project in further activities (other than those covered by the project, e.g. in other research activities; in developing, creating and marketing a product, process or service; in standardisation activities)."[3]

The concept standing behind the definition of exploitation, which is also the ultimate feature of the activity itself, is indeed the effective and concrete use of the achieved project outcomes. The exploitation aims at using Innovation actions to create a concrete impact for society, with the expectation that the exploitable results will be used beyond the lifetime of the project.

Task T8.6 is addressed to write the Plan for the Exploitation of the Results. Thus, the deliverables related to this task are intended to report all the activities performed through the journey of exploitation: starting from the identification and characterization of the project results, going through the formulation of an exploitation strategy and plan.

3.2 Exploitation Methodology

The OPTIMAI Exploitation activities aim at transforming the project's outcomes into exploitable assets to answer the needs of target market segments and to prepare market entry in the European manufacturing industry. The overall Exploitation strategy and objectives are summarised in the figure below and have been conceived to be aligned with the project Work Plan, phases and delivery of results.

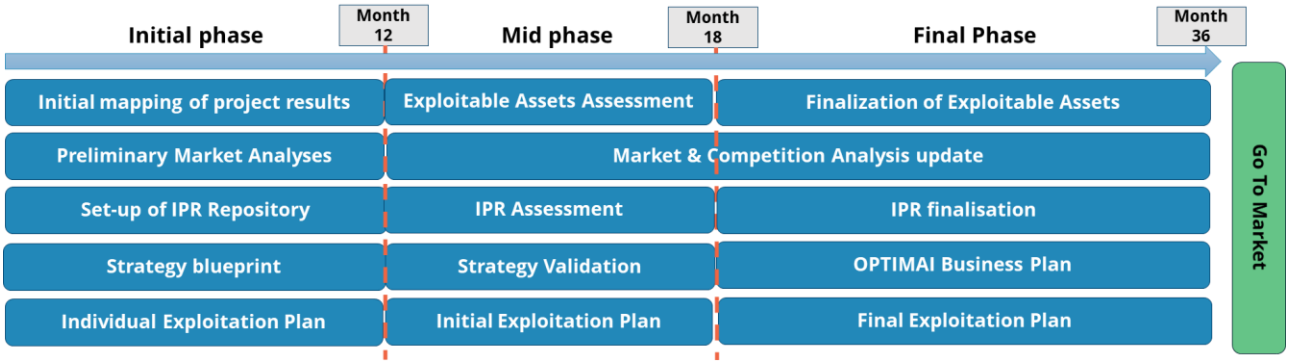

Figure 1 – OPTIMAI Exploitation Strategy

3.2.1 Initial Phase

The aim of the **Initial phase** (M1 to M12), reported in this deliverable, is to have an initial results' definition for OPTIMAI and the set-up of the structures to be used during the project lifecycle. In this phase, also each partner's Individual Exploitation commitments and intentions are drafted. Although the analysis in certain cases may appear as broad or theoretical, it is crucial to bring to

[3] https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/support/glossary

all partners a shared understanding of the potential routes opened up about the joint exploitation strategy and the OPTIMAI governance. To have, already after the first year into the project, a clear view of the potential OPTIMAI product(s) and to develop concrete Value Propositions and Business Models, we have already defined the exploitable results (described in detail in the next section). To make sure the assets will always be up-to-date and in line both with the project evolution and the market and needs, OPTIMAI partners have set up a 'Key Exploitable Results Repository' intended to be a live tool easy to update and monitor. This database also serves as a tool to define and monitor the IPR and its management, in the next Exploitation phases.

The first step of the process was aimed to support the partners in identifying the exploitable results: a specific template to collect the information concerning each result has been developed and shared with the partners. This template is also used to present the results in the following section. Thanks to the work performed in conjunction with Task 8.5, the template collects also details on IPR.

Table 1: KER Template

Exploitable Result Name	
Description	Please insert the description of the asset
Lead Partner	Please indicate the leading partner
Contributing Partners	Please indicate the partners contributing to the asset
Relevant WPs	Please indicate the WPs relevant for the asset
Relevant Deliverables (if any)	Please indicate the deliverables relevant for the asset
Completeness (%)	Please state the percentage of completion at the time of writing
Expected Delivery Date	Please indicate the expected delivery date
Type	Software, Hardware, Framework, Service, Guideline, Methodology, Documentation, Reference Architecture, etc…
Expected TRL by end of the project	Please indicate the expected TRL reached by the end of the project
Link (if applicable)	Please insert the link to the asset
Target stakeholders	Please indicate the target stakeholders of the asset
Foreseen IPR strategy (if any)	Please indicate the foreseen IPR strategy (Copyrighted, Service, Licensed, None) if applicable
Sole owner or co-ownership	Please indicate whether it will be a sole owner, co-ownership
"FTO - Freedom-to-Operate"	Please indicate the FTO or right to use for the asset (freedom to test, market, sell the product or service in a specific area)
Individual or joint exploitation	Please state if the asset will be exploited individually or jointly or use this column to state a possible joint exploitable result.

To simplify the collection of the information from all the partners this template has been used to set up the Key Exploitable Results Repository which will be updated regularly during the project lifecycle.

In parallel, all the partners were requested to provide their individual exploitation plan, providing details on the partner profile, identification of opportunities, addressable market and value propositions. The template provided to collect this information is reported in ANNEX I.

3.2.2 Mid Phase

The **Mid exploitation phase** (running from M13 to M18, which will be reported in D8.7) leveraging on the outcomes of the preliminary market analysis (D8.10), will set up a concrete Exploitation Plan. The KERs will be updated with a focus on their market value and business potential and the IPR Assessment will also be consolidated.

3.2.3 Final Phase

In the **Final exploitation phase** (M19 to M36, to be reported in D8.8), a Business Plan for OPTIMAI will be crafted. The Assets and their Value propositions will be updated both to follow the project results' evolution and to match the results of the demonstrators, in order to ensure the business mission and propositions are aligned to actual user needs. In this phase, the product positioning will be consolidated.

A post-project phase is also foreseen and will start after the end of the project implementation, featuring the actual commercialization roadmap and activities for OPTIMAI based on the Exploitation Plan defined in the previous phases.

4 Exploitation Strategy

This section presents the Exploitation Strategy outlined so far by the partners of the OPTIMAI project. The section is to be considered preliminary as it reflects the plans that the partners have at the current stage of the project (M12). A more complete and detailed version will be released in the next deliverables at M18 and M36.

4.1 Exploitable Results

The H2020 programme defines project results as "Any tangible or intangible output of the action (such as data, knowledge and information, whatever their form or nature, whether or not they can be protected), which are generated in the action, as well as any attached rights, including intellectual property rights"[4]

To be successful in writing the exploitation plan it is essential to start with the identification and characterization of the exploitable results. Indeed, not all of what has been achieved throughout the course of the project is likely to have an exploitation route. Exploitable results are only those having a potential scientific, economic and social significance. During the project these outcomes provide a mechanism to capture and quantify the impact, while, by the end of the project, a way to achieve impact beyond the project's completion.

The identification of the exploitable results is an ongoing process that starts at the proposal stage when a preliminary list of expected results is outlined. Some of the foreseen outputs become available throughout the course of the project, some towards the end, some may result not to be feasible, some new outputs may be identified. Therefore, it is of outmost importance to closely monitor project progresses to capture the results and to identify outcomes not foreseen at the beginning of the project, to follow up and manage them through the whole lifetime of the project.

Table 2: Integrated OPTIMAI platform

Integrated OPTIMAI platform	
Description	This exploitable result refers to the complete OPTIMAI solution zero defect manufacturing, including all technological components for data acquisition, AI analysis, quality control, virtualization, decision support, and human machine interaction.
Lead Partner	CERTH
Contributing Partners	All Partners
Relevant WPs	WP3, WP4, WP5, WP6
Relevant Deliverables (if any)	D6.3 (M35), C6.4 (M35)
Completeness (%)	25%

[4] https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/support/glossary

Expected Delivery Date	
Type	Software
Expected TRL by end of the project	TRL7
Link (if applicable)	
Target stakeholders	End-users
Foreseen IPR strategy (if any)	Copyrighted
Sole owner or co-ownership	Co-ownership
FTO - Freedom-to-Operate"	Access Rights will be given under previous agreement between parties involved.
Individual or joint exploitation	As this refers to the entire OPTIMAI framework co-developed by all project partners, it is a joint exploitable result

Table 3: Industrial vision sensors with AI-processing and seamless process integration

Industrial vision sensors with AI-processing and seamless process integration	
Description	Components for sensors (main focus: image processing) with integrated image analysis software and a big list of state-of-the-art communication interfaces.
Lead Partner	EVT
Contributing Partners	EVT (possible contributors: TVES, KLEE, FINT)
Relevant WPs	WP3
Relevant Deliverables (if any)	D3.1(M16), D3.2(M30)
Completeness (%)	17%
Expected Delivery Date	TBD
Type	Hardware/Software
Expected TRL by end of the project	TRL 7
Link (if applicable)	TBD
Target stakeholders	Customer base of EVT
Foreseen IPR strategy (if any)	Patents
Sole owner or co-ownership	EVT will be sole owner, but still TBD
FTO - Freedom-to-Operate"	Access right will be given under agreement.
Individual or joint exploitation	Individual exploiting strategy

Table 4: Data Repository

Data Repository	
Description	The Middleware platform provides secure interfaces between the various units, components, sensors and subsystems and it supports the network protocols required to exchange control and store data and information needed to facilitate operations and services in an environment with many different networking and system components.
Lead Partner	FINT
Contributing Partners	FINT (possible contributors from: EVT, YBQ, ENG, UPV, UNIMET, KLEE, TVES, MSL)
Relevant WPs	WP3
Relevant Deliverables (if any)	D3.3 (M18) D3.4 (M30)
Completeness (%)	25%
Expected Delivery Date	2023-06-30
Type	Software
Expected TRL by end of the project	TRL7
Link (if applicable)	
Target stakeholders	FINT
Foreseen IPR strategy (if any)	FINT hereby excludes from its obligation to grant Access Rights to all Background other than generated by research personnel involved in the project as well as to all Background other than explicitly needed for the project.
Sole owner or co-ownership	
FTO - Freedom-to-Operate"	Specific background will be accessible royalty-free strictly on a need-to know basis and in the context of work plan as defined in the Grant Agreement
Individual or joint exploitation	It will be exploited both individually and jointly with other components

Table 5: Middleware

Middleware	
Description	A software platform which will provide the resources' virtualisation layer while providing a specific horizontal module that will handle all intra and inter middleware communication protocols and procedures. Moreover provide a universal API for handling the data exchange, will host and execute the Data Fusion mechanisms and will provide an administrative web console for visualisation of raw data that is coming from the various sensors and devices

ead Partner	FINT
Contributing Partners	FINT (possible contributors from: EVT, YBQ, ENG, UPV, UNIMET, KLEE, TVES, MSL)
Relevant WPs	WP3
Relevant Deliverables (if any)	D3.3 (M18) D3.4 (M30)
Completeness(%)	25%
Expected Delivery Date	2023-06-30
Type	Software
Expected TRL by end of the project	TRL7
Link (if applicable)	
Target stakeholders	FINT
Foreseen IPR strategy (if any)	FINT hereby excludes from its obligation to grant Access Rights to all Background other than generated by research personnel involved in the project as well as to all Background other than explicitly needed for the project.
Sole owner or co-ownership	
FTO - Freedom-to-Operate"	Specific background will be accessible royalty-free strictly on a need-to know basis and in the context of work plan as defined in the Grant Agreement
Individual or joint exploitation	It will be exploited both individually and jointly with other components

Table 6: Blockchain framework

Blockchain framework	
Description	Within an actual production line, Distributed Ledger Technologies (DLT) will give a decentralized solution for real-time validity and traceability. Appropriate mechanisms and smart contracts for industrial applications will be deployed to implement: access control (ownership, permissioning) and management for produced data through the adoption of Decentralized Digital Identities (DIDs), validation of firmware or software installed on sensors and OPTIMAI middleware, the integrity of data produced and exchanged from/to the critical sensors of the production line through data logging, iv) immutable data produced and exchanged from/to the critical equipment. A transparent yet strong blockchain layer towards zero-defect manufacturing will be ensured by common security protocols and standards (including standardized data encryption).
Lead Partner	CERTH

Contributing Partners	FINT, ENG
Relevant WPs	WP3
Relevant Deliverables (if any)	D3.5 (M30)
Completeness (%)	15%
Expected Delivery Date	
Type	Framework
Expected TRL by end of the project	TRL7
Link (if applicable)	
Target stakeholders	End-users
Foreseen IPR strategy (if any)	Copyrighted
Sole owner or co-ownership	Co-ownership
FTO - Freedom-to-Operate"	Access Rights will be given under previous agreement between the parties involved.
Individual or joint exploitation	It will be exploited both individually and jointly with other components

Table 7: Security middlebox

Security middlebox	
Description	The Security Middlebox facilitates the use of acceleration (FPGA) for detecting and analysing cybersecurity threats, for monitoring and managing the AI and cybersecurity algorithms and provides the communication/interfacing modules, that will enable for the interaction with other external components (central logging server, software agents, etc.)
Lead Partner	FINT
Contributing Partners	FINT (possible contributors from: CERTH, EVT, YBQ, ENG, UPV, TRI)
Relevant WPs	WP3
Relevant Deliverables (if any)	D3.5 (27)
Completeness (%)	0%
Expected Delivery Date	2023-03-31
Type	Hardware/Software
Expected TRL by end of the project	TRL7
Link (if applicable)	
Target stakeholders	FINT

Foreseen IPR strategy (if any)	FINT hereby excludes from its obligation to grant Access Rights to all Background other than generated by research personnel involved in the project as well as to all Background other than explicitly needed for the project.
Sole owner or co-ownership	Possibly FINT will be sole owner, but still TBD
FTO - Freedom-to-Operate"	Access Rights shall be given under previous agreement between parties involved.
Individual or joint exploitation	It will be exploited both individually and jointly with other components

Table 8: On-the-edge processing component

On-the-edge processing component	
Description	This component is part of the edge node architecture. It enables: Deployment of AI services on-the-edge; Smart data management and data distribution mechanisms; Correct circulation of data across all the OPTIMAI endpoints; Micro-service execution at edge nodes
Lead Partner	ENG
Contributing Partners	TBD (possible contributions from: CERTH, FINT, EVT, YBQ, UNIMET, UAB)
Relevant WPs	WP3
Relevant Deliverables (if any)	D3.6 (M18) D3.7 (M24)
Completeness (%)	20%
Expected Delivery Date	2022-12-31
Type	Software
Expected TRL by end of the project	TRL7
Link (if applicable)	TBD
Target stakeholders	TBD
Foreseen IPR strategy (if any)	TBD
Sole owner or co-ownership	TBD
FTO - Freedom-to-Operate"	Access Rights shall be given under previous agreement between parties involved.
Individual or joint exploitation	It will be exploited both individually and jointly with other components

Table 9: Virtual sensors and actuators

Virtual sensors and actuators

Description	This software module will be used to virtualize sensors and will enable for the prediction and estimation of the sensor's future physical readings; these readings will be compared to the actual real values stemming from the physical counterpart sensors.
Lead Partner	FINT
Contributing Partners	FINT (possible contributors from: EVT, VIS, UPV, KLEE, TVES, MSL)
Relevant WPs	WP4
Relevant Deliverables (if any)	D4.3 (M22) D4.4 (M33)
Completeness (%)	0%
Expected Delivery Date	2023-06-30
Type	Software
Expected TRL by end of the project	TRL7
Link (if applicable)	
Target stakeholders	FINT
Foreseen IPR strategy (if any)	FINT hereby excludes from its obligation to grant Access Rights to all Background other than generated by research personnel involved in the project as well as to all Background other than explicitly needed for the project.
Sole owner or co-ownership	Possibly FINT will be sole owner, but still TBD
FTO - Freedom-to-Operate"	Access Rights shall be given under previous agreement between parties involved.
Individual or joint exploitation	It will be exploited both individually and jointly with other components

Table 10: AI models for zero defect

AI models for zero defect	
Description	AI approaches for detecting flaws and forecasting potential ones when equipment or materials are near to the margin of error will be developed for real-time sensory data analysis. To address the data scarcity of defective parts, reference datasets will be created early in the project's lifecycle, and open datasets containing both healthy and defective samples will be used. Not only will supervised AI models be used in the research, but also unsupervised methods for anomaly detection and deep generative models for novelty discovery, which have a lot of scientific and innovative potential. Time series models will be utilized to forecast over 1D signals for defect prediction, while deep

	recurrent networks will be trained based on successive sensory measurements for defect prediction.
Lead Partner	CERTH
Contributing Partners	UTH, EVT, ENG, UNIMET, VIS
Relevant WPs	WP3, WP4
Relevant Deliverables (if any)	D3.6(M30), D4.3 (M33)
Completeness (%)	
Expected Delivery Date	
Type	Software
Expected TRL by end of the project	TRL7
Link (if applicable)	
Target stakeholders	End-users
Foreseen IPR strategy (if any)	Service
Sole owner or co-ownership	Co-ownership
FTO - Freedom-to-Operate"	Access Rights will be given under previous agreement between parties involved.
Individual or joint exploitation	It will be used both independently and in conjunction with other components.

Table 11: Computer vision module for AR

Computer vision module for AR	
Description	This exploitable result will include computer vision techniques for understanding operator's intentions from contextual and motion analysis. To this end techniques for activity and gesture recognition will be developed for analysis ego-centric video from the camera on the AR glasses. In addition, to understand context algorithms for detecting particular objects of interest will be developed that will include production parts, tools or production equipment.
Lead Partner	CERTH
Contributing Partners	FORTH, UNIMET, YBQ
Relevant WPs	WP5,WP6
Relevant Deliverables (if any)	D5.1 (M20) D6.1 (M15) D6.2 (M30)
Completeness (%)	
Expected Delivery Date	
Type	Software

Expected TRL by end of the project	TRL7
Link (if applicable)	
Target stakeholders	End-users
Foreseen IPR strategy (if any)	Service
Sole owner or co-ownership	Co-ownership
FTO - Freedom-to-Operate"	Access Rights will be given under previous agreement between parties involved.
Individual or joint exploitation	both independently and in conjunction with other components.

Table 12: Intelligent marketplace

Intelligent marketplace	
Description	The Intelligent Marketplace aims to help the manufacturing ecosystem players to decrease scrap within their production line. It will provide service's based on AI algorithms developed in OPTIMAI, to third parties that would like to increase their production quality by minimizing scrap (using OPTIMAI Identification of potentially defective parts and prediction of defects and malfunctions algorithm) or to using the defective parts of an Industry that for them are not scrap but useful (prior to the recycling process or after it (reuse of scrap for lab measurements and material properties studying)
Lead Partner	FINT
Contributing Partners	FINT (possible contributors from: CERTH, FORTH)
Relevant WPs	WP6
Relevant Deliverables (if any)	D6.3 (M15) D6.4 (M34)
Completeness (%)	0%
Expected Delivery Date	2023-10-31
Type	Software/Service
Expected TRL by end of the project	TRL7
Link (if applicable)	
Target stakeholders	FINT
Foreseen IPR strategy (if any)	FINT hereby excludes from its obligation to grant Access Rights to all Background other than generated by research personnel involved in the project as well as to all Background other than explicitly needed for the project.

	Specific background will accessible royalty-free strictly on a need-to know basis and in the context of work plan as defined in the Grant Agreement
Sole owner or co-ownership	Possibly FINT will be sole owner, but still TBD
FTO - Freedom-to-Operate"	Access Rights shall be given under previous agreement between parties involved.
Individual or joint exploitation	It will be exploited both individually and jointly with other components

Table 13: Decision support and early notification framework

Decision support and early notification framework	
Description	The Decision Support System will improve end-user decision-making and provide notifications for predictive maintenance actions based on early detection of defects or prediction of upcoming malfunctions. The goal is to help worker execute complex tasks in an optimal way and have a global perspective on multistage production processes, effectively dealing with multi-dimensional data.
Lead Partner	CERTH
Contributing Partners	FORTH, ENG
Relevant WPs	WP5, WP6
Relevant Deliverables (if any)	D5.1(M20) D5.2 (M30), D6.1 (M15), D6.2 (M30)
Completeness (%)	10%
Expected Delivery Date	
Type	Software
Expected TRL by end of the project	TRL7
Link (if applicable)	
Target stakeholders	End-users
Foreseen IPR strategy (if any)	Service
Sole owner or co-ownership	Co-ownership
FTO - Freedom-to-Operate"	Access Rights will be given under previous agreement between parties involved.
Individual or joint exploitation	both independently and in conjunction with other components.

Table 14: Ethics recommendations & regulatory framework

Ethics recommendations & regulatory framework	
Description	Ethics and legal requirements will be provided for pilot sites taking into consideration the particularities of national legislation of each pilot site.
Lead Partner	TRI
Contributing Partners	TRI, UAB, CERTH
Relevant WPs	WP7
Relevant Deliverables (if any)	D7.3 (M18)
Completeness (%)	0
Expected Delivery Date	2022-06-31
Type	Guideline
Expected TRL by end of the project	
Link (if applicable)	
Target stakeholders	TELEVES, KLEE, MTCL
Foreseen IPR strategy (if any)	
Sole owner or co-ownership	
FTO - Freedom-to-Operate"	Public distribution
Individual or joint exploitation	Ethics and legal requirements will be provided for pilot sites taking into consideration the particularities of national legislation of each pilot site.

Table 15: OPTIMAI Regulatory Model

OPTIMAI Regulatory Model	
Description	
Lead Partner	UAB
Contributing Partners	TRI and Dr. Mustafa Hashmi (external expert)
Relevant WPs	WP9
Relevant Deliverables (if any)	D9.5 (M6); D9.6 (M12); D9.7 (M24); D9.8 (M36)
Completeness (%)	33%
Expected Delivery Date	2023-12-31
Type	Methodology
Expected TRL by end of the project	TRL7
Link (if applicable)	TBD
Target stakeholders	TBD
Foreseen IPR strategy (if any)	TBD

Sole owner or co-ownership	TBD
FTO - Freedom-to-Operate"	TBD
Individual or joint exploitation	TBD

Table 16: OPTIMAI Training

OPTIMAI Training	
Description	
Lead Partner	CARR
Contributing Partners	CERTH, FINT, VIS, YBQ, UTH, ENG, UNIMET, UAB, TRI, KLEE, TVES, MSL
Relevant WPs	WP7
Relevant Deliverables (if any)	D7.1 (M20), D7.2 (M30)
Completeness (%)	0%
Expected Delivery Date	2022-08-30
Type	Documentation
Expected TRL by end of the project	N/A
Link (if applicable)	TBD
Target stakeholders	TBD
Foreseen IPR strategy (if any)	Identify materials that could be subject to license / patenting
Sole owner or co-ownership	TBD
FTO - Freedom-to-Operate"	TBD
Individual or joint exploitation	TBD

Table 17: Communication and dissemination strategy

Communication and dissemination strategy	
Description	Impactful C&D strategy that can be applied and tailored to a broad range of fields and contexts
Lead Partner	CARR
Contributing Partners	N/A
Relevant WPs	WP8
Relevant Deliverables (if any)	D8.2 (M6), D8.3 (M18), D8.4 (M36)
Completeness (%)	100%
Expected Delivery Date	2021-06-30
Type	Report

Expected TRL by end of the project	N/A
Link (if applicable)	N/A
Target stakeholders	TBD
Foreseen IPR strategy (if any)	Identify materials that could be subject to license / patenting
Sole owner or co-ownership	TBD
FTO - Freedom-to-Operate"	TBD
Individual or joint exploitation	TBD

Table 18: OPTIMAI Business Model

OPTIMAI Business Model	
Description	The business model that will be applied in OPTIMAI to bring the results of the project to the market. It will present the possibilities of advancing and developing the OPTIMAI system beyond the initial funding period.
Lead Partner	ENG
Contributing Partners	ALL
Relevant WPs	WP8
Relevant Deliverables (if any)	D8.6 (M12) D8.7 (M18) D8.8 (M36) D8.9 (M36)
Completeness (%)	30%
Expected Delivery Date	2023-12-31
Type	Report
Expected TRL by end of the project	N/A
Link (if applicable)	N/A
Target stakeholders	TBD
Foreseen IPR strategy (if any)	TBD
Sole owner or co-ownership	TBD
FTO - Freedom-to-Operate"	TBD
Individual or joint exploitation	TBD

4.2 IPR Management

Intellectual Property Rights (IPRs) are related to the legal rights that protect creations and/or inventions resulting from intellectual activity in the industrial or scientific fields. The most common IPRs include patents, copyrights, marks and trade secrets. In this sense, OPTIMAI

project is defining and agreeing upon an IPR management strategy to ensure exploitation objectives are met for the exploitable assets resulting from the project, considering ownership and intellectual property subjects. In six months before the end of the project partners will be in a position to apply for any relevant patents or decide on the type of licence for the early use and exploitation of technologies.

However, for M1 to M12, the IPR topic is on an initial phase. As the first step, IPR and FTO foreground from consortium partners technologies and data are assessed. Consequently, the OPTIMAI consortium will protect that data and knowledge, and get the approval of concerned partners before every data publication. Then, is needed to have an initial exploitation assets identification, whether they are of individual or joint ownership, assess all partner's Individual Exploitation commitments and intentions, and bring to all partners a shared understanding of the importance of defining an asset to exploit and potential routes opened up with regard to the joint exploitation strategy.

Both tasks 8.5 and 8.6 have a foundation on the exploitable results that come out of the OPTIMAI project, the reason why a common table has been shared with partners to collect all information regarding KERs and IPR. To make sure the assets will always be up-to-date and in line both with the project evolution and the market and needs, an 'Assets Database repository' has been set, intended to be a live tool easy to update and monitor, and it will also serve as a tool to better define and monitor the IPR and its management, in the next Exploitation phases.

In coming mid and final project phases, a more depth IPR assessment will be consolidated. And, after the IP protection route has been defined for each "result" in the IPR registry (Assets Database repository), dissemination actions will take place for some of them (for example for those for which a patent application has been submitted).

4.3 Individual exploitation plan

In addition to the consortium as a whole, individual partners will pursue their own exploitation activities: every partner has defined his own exploitation initiatives and the assimilation of OPTIMAI project outcomes in his area of interest or specific business.

In particular, for each partner following details are reported:

- **Partner profile**: a description of the company/organization, reporting attitude to innovation, research activities, experience in big distributed projects, and specific role in the consortium.
- **Identification of opportunities**: a description of the way OPTIMAI project results and outcomes are relevant to improve each partner business and activities, gaining a better positioning in the markets/areas of action or opening new possibilities in different ones. It can contain an explanation of which customers' needs will be fulfilled by the exploited results of the project.
- **Addressable Market**: Overview of the target audiences where OPTIMAI can be applied and how, identifying what kind of needs customers or stakeholders have or what kind of expectations the solution needs to fulfil.

- **Value propositions**: details about the specific approach and actions to use the value of the results of the project in each area of business.

The Individual Exploitation Plan template is reported in Annex I Individual Exploitation Plan Template.

4.3.1 Centre for Research and Technology Hellas - Information Technologies Institute (CERTH-ITI)

4.3.1.1 Partner Profile

CERTH as a research organization is primarily interested in promoting science and generating new knowledge. CERTH has extensive experience in large-scale research projects particularly in Industry 4.0. As the coordinator of the project, it leads WP1 for project management and WP6 for "Decision support and system integration" while having horizontal contribution in all other work packages. As a computer science research centre, CERTH is mainly involved in the development of AI methodologies for zero defect manufacturing and decision support. CERTH is also the main contributor in the blockchain framework that will be developed for OPTIMAI end-users. CERTH is a non-profit organization, thus it cannot directly commercialize the developed technology but its main exploitation route, is the gained expertise and knowhow that is transferred in other research initiatives and disseminated in high impact scientific publications. This way CERTH can enhance its track record in research and innovation and create new synergies with public and private organizations. An alternative way of exploitation is through spin-off companies involving the main scientific personnel working the project that can commercialize research results either directly or as part of a joint venture.

4.3.1.2 Identification of opportunities

An important opportunity for CERTH in order to improve its positioning with respect to other research organizations, can be pinpointed in the blockchain platform that is currently developed. This platform will enable the secure connection of Web / Cloud Platforms with a private Ethereum Blockchain, allowing for efficient permission management for collected data. The blockchain can be used and extended in OPTIMAI to enable the immutable recording of: i) AI system choices in the context of Trustworthy AI; ii) operators actions allowing for traceability of upstream causes of particular production outputs

AI analytics algorithms for zero defect manufacturing is another opportunity for CERTH as it will enhance its research portfolio for the detection and prediction of defects thus enabling their prevention and containment before they are propagated in the next production phases. Through its involvement in different pilot sites CERTH will create complementary AI methods for zero defect manufacturing thus expanding its AI portfolio for Industry 4.0 and facilitating the delivery of AI solutions for different industrial sectors.

CERTH is also involved in the interaction and visualization of results to the operator through AR gear and the proposed Decision Support framework. This technology can be used to improve workers productivity by carrying out equipment calibration and inspection tasks faster and in a more efficient way. This can lead to new ways of interaction between workers and production equipment that can be expanded to other industries as well.

4.3.1.3 Addressable Market

Target audiences for CERTH can be divided in two categories. The first one is the scientific and research community that will be reached through high impact scientific publications with the goal being to enhance CERTH scientific profile and publications track record. The second one are industries and R&D industrial groups that can use OPTIMAI technology in their shopfloors and manufacturing processes. Of course as OPTIMAI focusses on specific industries, it is closer to the markets of microelectronics, antennas and lift manufacturing but the solutions under development are designed so that they can be generalized in other sectors as well.

4.3.1.4 Value propositions

The pilot demonstrations of the project will verify the value of the results, allowing end-users to evaluate the developed technology and provide their feedback. Prior to the demonstrators, each technology will be individually developed and tested using offline data collected from each factory. Concretely for the blockchain framework, the first step is to identify the actions and events that should be recorded in the ledger and then proceed with basic test net implementations that will evolve as project progresses. Eventually the blockchain framework with be connected to the OPTIMAI middleware to record and verify ongoing transactions. The basic value proposition for end-users is to enable full traceability over specific courses of actions that lead to particular production outputs that will also facilitate root cause analysis for critical events in the shopfloor, like the cause of a defect that has appeared or the malfunction of a machine.

Regarding AI analysis, its value proposition can be summarized in the minimization of defects and production downtime. The first step to this end is the in-lab study of defective parts in order to understand the type of defects and determine the most appropriate sensors. Afterwards, AI models will be trained for defect detection and prediction while appropriate sensors will be integrated in the shopfloor and connected to the OPTIMAI middleware. Having established this testing infrastructure, the AI models will be fine-tuned and we will proceed to demonstrators' phase where the OPTIMAI AI solutions will be verified in operational environment by the project end-users. The industry partners of the project are planned to be the early adopters of the developed technology, but other industries will be contacted through the outreaching activities of WP8.

Finally, CERTH proposes new ways for the interaction of operators in the shopfloor and production equipment. Concretely, computer vision techniques will be developed to understand operators' actions and intentions and then send appropriate actuation signals that will speed up and facilitate production setup tasks. At the same time a Decision Support framework is developed to forward AI results and provide suggestions to workers. To accomplish this, the first step is to document the operators' actions that should identified and generate training datasets according to defined gestures and signals. Afterwards, actuators will be interconnected in laboratory with the outputs of computer vision modules in order to ensure high precision and recall before actual deployment. Analysis will be performed on the video signal of the AR glasses, having a user-centric viewpoint. Decision support outputs will be visualized in the AG glasses and end-to-end tests will be carried out in the laboratory. The next step is to train end-users in

these new ways of interaction and perform small scale pre-trial tests, before proceeding to the final pilot demonstrators. The value proposition of CERTH is to increase productivity of workers by enhancing their situational awareness, providing a complete view of a particular process, and relieving them of menial tasks for setup and calibration that can be automated through the actuation network.

4.3.2 Future Intelligence Limited (FINT)

4.3.2.1 Partner Profile

Future Intelligence (FINT) is a leading and highly innovative Group of Companies specialising in Information and Communication technologies (ICT). The Group was initially established in Greece in 2009, is privately held and its main facilities are located in Greece, the United Kingdom and Cyprus. FINT provides highly demanding solutions and business services covering a number of activities, in the fields of long-range communications (WiMAX, LTE, 5G), short-range communications (WSN, M2M, IoT), and Future Internet (distributed cloud environments, artificial intelligence).

FINT is one of the leading IoT devices manufacturers in Europe. The company's objective is to build an IoT-enabled ecosystem which can expand horizontally and vertically providing a playground for vendors, OEMs and software engineers. The main platform that FINT provides is commercialised under the name FINoT®.

Current commercial and research activities include next generation networks (network virtualisation), sensor adaptation and data interpretation techniques, data mining and data provision through cloud-based applications, distributed computing techniques (EDGE computing) and big data analytics.

In addition to contributing to breakthrough and innovative scientific research through its RnD facilities (FINT Labs) in Greece (Athens: IoT manufacturing, Heraklion: Cloud Infrastructure and services), the United Kingdom (London: PCP, FPGAs, Heterogeneous Processing, Intelligent Surveillance), and in Cyprus (Limassol: AI, Blockchain, etc). Related to the above fields, the focus is to pitch in with other players in order to produce innovative and original products and services.

The company itself and its core personnel have participated in key roles in more than 50 EC co-funded R&D projects (FP6, FP7, INTERREG-MED, SEE, LIFE, PRIMA, H2020) in the domains of ICT, TRANSPORT, HEALTH, SECURITY, ENVIRONMENT, AGRICULTURE and DT.

4.3.2.2 Identification of opportunities

FINT has significant experience in Industrial automation projects. Through introduction of FINoT platform to the project, several developments of OPTIMAI had been identified as main commercialisation opportunities for the company. Specifically, FINT provides as a commercial solution a middleware service that can incorporated knowledge, data, algorithms from heterogeneous sources and can be used from its clients using it in Smart Cities, Smart Agriculture, Smart Infrastructure and Industrial Automation for Manufacturing domain. Moreover, FINT is one of the first companies in Europe which provided a marketplace for services and data sharing using a complete FIWARE-based platform along with a Marketplace creator for

virtualisation function deployment and operation at FPGAs accelerating platform. The work that FINT undertook in OPTIMAI will definitely help to further develop its solutions and show case its capabilities to industrial parties.

4.3.2.3 Addressable Market

Currently, the Core FINoT Platform – which will be the foundation upon which the OPTIMAI middleware platform will be built – is commercially used in the domains of smart cities and smart infrastructures. Through the expansion and enhancement of the platform to satisfy the needs of the OPTIMAI project, FINT will be in an advantageous position of being able to bring this innovative technology into the industrial domain, a market which the company have strategically aimed to penetrate.

The marketplace will also expand the company's know-how and expertise in the software domain, as the already market available company's solutions in the smart cities/infrastructure domains.

4.3.2.4 Value propositions

FINT is following OPTIMAI project activities, trying to establish three concurrent exploitation channels: (a) Establish license-based collaborations with other participants by providing parts of FINoT platform; (b) License FINT's developments in terms of middleware and marketplace to other partners of the consortium as well as to other parties outside of it; (c) Participate in joint ventures with other partners, promoting common developments.

4.3.3 Foundation for Research and Technology Hellas (FORTH)

4.3.3.1 Partner Profile

The Foundation for Research and Technology-Hellas (FORTH) is one of the larger Research Centres of Greece, employing highly qualified personnel and an internationally acknowledged reputation as one of the top research institutions in Europe. In particular, FORTH's Institute of Computer Science (ICS) is focused on: (i) conducting basic and applied research; (ii) developing applications and products; (iii) providing services; and (iv) pursuing and maintaining leadership both nationally and internationally, in the fields of Information and Communication Technologies (ICT).

ICS-FORTH is represented in OPTIMAI by The Human Computer Interaction (HCI) Laboratory, internationally recognised center of excellence, conducting research regarding critical domains such as Human-Computer Interaction, Universal Access, Computational Vision, Artificial Intelligence, Semantic-based Knowledge Systems, Robotics, Networks and Telecommunications, Distributed Systems, Microelectronics, etc. The activities of the Laboratory include among others the design of human-centric smart environments, the development of ambient intelligence technologies, and the assessment of those technolgies' impact on both the individual and societal level. The Laboratory has extensive expertise in the implementation of large-scale National and EU-Funded research and innovation activities, with a well-known profile particularly regarding the technical management of international project networks and activities involving academic and industry partners. In OPTIMAI specifically, regarding the system implementation,

ICS-FORTH is in charge of both the integrated AR environment development for the on-the-fly production (re)-configuration; as well as Graphical User Interfaces (GUIs) and HCI modules.

Activities of ICS-FORTH address important research and development areas, encompassing new perspectives, emerging fields of research and technological challenges. In its continuing efforts to exploit its research activities and results, the Institute contributes significantly to the diffusion of modern ICT solutions in both the public and private sectors, acting as a catalyst for the creation of an Information Society acceptable by all citizens. As such, ICS-FORTH has an extensive track record of commercially relevant research, which has notably led to several patents, successful start-ups, and important technologies used by ICS-FORTH partners worldwide

4.3.3.2 Identification of opportunities

FORTH identifies the Augmented Reality framework and applications it will develop in the context of Task 5.2 (e.g., defect detection analysis; remote manipulation via gesture-driven input; etc.) as the component with the highest exploitation potential out of its contributions to the project. The components for rendering and AR interaction are seen as relevant for both (i) improving internal ICS-FORTH research and training activities, capitalizing on the gained experience toward forming future collaborations within the HORIZON framework promoting the groups specialty with AR using the proven track record of applying these tools in manufacturing domain in the context of OPTIMAI; and (ii) seeking to diffuse products of OPTIMAI cutting-edge research to various vertical domains and potential interested buyers (see Section below). The following assets will be examined more closely throughout the duration of the project in order to assess exploitation possibilities:

On-the-fly reconfiguration of production equipment: The unique contribution with this module lies in the combination of a wearable visualisation solution for defect inspection and analysis with cutting-edge AI approaches for fault detection and defect prediction. The added capacity for operators to reconfigure equipment parameters using gestures is expected to be of significant interest to the target audience, particularly in cases where human presence is deemed too dangerous for enabling manual operations. This will be possible through an integration of sophisticated computer vision algorithms used for recognising and detecting gestures, which (as an independent module) may also find application in other domains, such as accessibility (e.g. sign language interpretation) and other interesting natural interaction use cases (e.g., in hands-free virtual reality scenarios).

4.3.3.3 Addressable Market

FORTH's target audience includes research and academia, who are expected to benefit from the contribution of knowledge and evidence regarding the implemented OPTIMAI processes, the introduction of new instruments (e.g., AR) and computing systems in manufacturing and overall advances proposed to the current state of the art. Furthermore, FORTH's solutions will target major national/international manufacturing companies, who may exploit or use the proposed developed products in their manufacturing lines.

Finally, several vertical domains may be identified over the course of the project who may have an interest in the proposed AR solution. Initial market research has shown AR tools to be

particularly sought after by buyers in the manufacturing industry, but also first responder organisations and disciplines, cultural heritage organisations, entertainment industry, etc. The potential penetration of the proposed tools in the aforementioned markets will be examined throughout the duration of the project.

4.3.3.4 Value propositions

ICS-FORTH technical contributions to the OPTIMAI project are of significant exploitation interest to the HCI Laboratory. Therefore, ICS-FORTH has structured its individual exploitation plan on two major pillars.

Of particular importance to ICS-FORTH is the capacity to exploit knowledge generated from its own (as well as other joint research) activities in the project, toward the benefit of improving ICS-FORTH's scientists and developers' background and processes. Particularly, the knowledge gained from the integration of the solutions and exploitable assets in real, operational factory shop floor environments is expected to significantly enhance the understanding and technical know-how of ICS-FORTH' personnel, particularly the people directly involved in project activities, which will allow them to both gain experience in co-creating and approbating of the proposed, as well as future similar products, with a direct consequence being the application of that knowledge toward future collaborative Research and Development (R&D) activities.

The second pillar of FORTH's exploitation strategy lies in the publication of its results in high-profile, high-impact venues for dissemination, such as high impact factor journals and premiere international conferences. Targeting the research and academia group, FORTH expects to benefit from usage of the scientific discoveries, measured using the relative rate of citation index of its project-related publications.

4.3.4 EVT Eye Vision Technology GmbH (EVT)

4.3.4.1 Partner Profile

EVT develops hardware and software for machine vision solutions. Standard Software (ready to use) for integrators and OEM customers as well as specialized sensors and light systems to realize solutions for special markets. EVT was established in 2007 with a clear focus on standard products for the machine vision market. EVT is a Manufacturer of machine vision software for VisionSensors, SmartCameras and PC Systems – EyeVison, the one software for all Hardware Platforms.

The early beginnings last back to 1999 where Michael Beising, a student at KIT (Karlsruhe Institute of Technology) with the clear idea to create "easy to use" software for machine vision solutions first developed the software. The idea was to enable even a layman to create complex machine vision solutions, using a fast time-to-market approach.

A few years later, based on the needs of customers, EVT also started to develop specialised hardware for machine vision solutions. This is mainly hardware that can't be found on the market, or that enables the market access based on suitable hardware for a target market.

In the meantime, the software has been sold either as a stand-alone solution or integrated in embedded systems in original equipment manufacturer (OEM) machines.

Today the focus is on enabling the power of the new technologies such as 3D, Thermal, Hyperspectral imaging, but also the latest Deep Learning technologies.

EVT's role in OPTIMAI:

EVT contributes in activities related to hardware and software development as well as for machine vision solutions. EVT brings their expertise in vision sensors into the Task 3.2 Multisensorial data acquisition and actuation network where it plans to develop components that can be used in the specific scenarios.

This implies the development of software components (cloud/edge architecture specific middleware) and the integration of developed HW and SW components into edge devices (IoT-enabled). EVT will also contribute to the development of the DSF, within OPTIMAI holistic platform. Furthermore, EVT will participate in the demonstration activities supporting the planning, preparation and deployment of adaptive sensorial network technologies in the pilots

4.3.4.2 Identification of opportunities

The major strategic goal is to extend the exploitation of their know-how in manufacturing processes. For that, EVT intends to transit the nowadays resource-based, hardware-oriented business models to more skill-based, service-oriented models.

EVT as an industrial partner mainly targets on a broad dissemination and communication of its individual results to their customers. The stakeholders for the dissemination activities involve all customer groups of EVT. Major efforts will be spent to reach the automotive end users and their direct suppliers. EVT will use all dissemination channels available (a) the website and other online platforms (e.g. LinkedIn, YouTube channel), (b) the EVT'S quarterly newsletters, and (c) direct customer contacts at fairs.

4.3.4.3 Addressable Market

EVT has a broad customer base worldwide. Especially in Germany automotive industries and their direct suppliers have a high demand for direct integration of the systems into their middleware. OPC UA and MQTT are requested but very often only partially realized. EVT sees a big opportunity to help a lot of medium sized customers to transform into a more efficient production process based on the techniques from OPTIMAI.

4.3.4.4 Value propositions

Results will contribute to improve the development of EVT's standard products. EVT will integrate the gained technology to the products to have an easier way to the markets like semiconductor, automotive, food and pharma and battery industry. EVT will investigate the overall results of the OPTIMAI project and expects to gain from the new relations with project partners.

4.3.5 Visual Components Oy (VIS)

4.3.5.1 Partner Profile

Visual Components (VIS) is recognized as a global leader in the manufacturing simulation industry and a trusted technology partner to many leading brands in industrial automation. Founded in 1999, Visual Components has been focused on developing innovative 3D simulation

and visualization solutions to make factory design and simulation technology easier to use and more accessible to manufacturing organizations of all sizes.

The 3D factory simulation and visualization suite offered by Visual Components consists of innovative tools, which set the standard for modern simulation. The simulation suite gives machine builders, system integrators, and manufacturers worldwide a simple, quick, and highly cost-effective way to build and simulate their total process solutions. With solutions for sales, manufacturing planning and optimization, offline programming, and virtual commissioning, Visual Components software is trusted by hundreds of organizations worldwide to support critical planning and decision-making processes and to build the digital twins of their production facilities.

Visual Components is actively involved in research and innovation activities, participating in several research projects in European and national initiatives, and further developing its simulation solutions. The solutions developed within the projects are targeted to be released as commercial solutions after the end of the projects.

4.3.5.2 Identification of opportunities

Providing solutions for machine builders, systems integrators, and end-users within the different verticals is the target of Visual Components. The research and development targets of OPTIMAI project targeting developing solutions for creating the digital twin of the manufacturing systems through the system virtualization is aligned with the objectives of Visual Components.

The project is intended to extend the virtualization capabilities of Visual Components 4.0, by extending the interfaces for modelling the manufacturing process. This will facilitate the development of virtual replicas of the manufacturing processes. The capabilities for sensor modelling and virtualization will be enhanced to cover the OPTIMAI's use cases requirements. Machine builders and system integrators will get advantage from the capabilities once introduced in the commercial solutions as the development of virtual production environments will be faster and more reliable. In addition, the extension of the simulation engine to be developed within OPTIMAI will increase productivity for end-users and facilitate the systems integration for integrators.

4.3.5.3 Addressable Market

Although the use cases covered in OPTIMAI belong to two specific verticals, elevation equipment, and electronics, mainly focusing on two domains of consumer electronics (antennas and PCBs), the solutions developed during the OPTIMAI project are intended to be extended to different domains, and in various verticals such as automotive, aerospace,etc.

The solutions developed within OPTIMAI, in addition, to being part of the commercial offer after the end of the project, will also be available in the education and research products to open access to the educational community for the new professionals and research purposes.

4.3.5.4 Value propositions

After completing the project, Visual Components targets commercializing the developments within OPTIMAI, including them into the commercial offer. During the project, the potential of

the different solutions developed and how they should be commercialized to maximize the income will be studied. In contrast, the go-to-market strategy will be developed.

An initial study allows us to predict an increase of 15% in sales after the first year of commercialization, increasing up to 35% during the following two years. This go-to-market study is focused on the commercialization of the solutions as a plug-in, extensions in the product functionalities, and the offering of related software services and consulting for the different domains where we foresee its utilization.

4.3.6 Youbiquo (YBQ)

4.3.6.1 Partner Profile

Youbiquo is a B2B product company focused on the design and development of wearable devices for enterprises who want to benefit of Augmented Reality and Artificial Intelligence wearable electronics in the Public Safety & Disaster Relief (PPDR) and Industry 4.0 ecosystems.

Youbiquo since 2015 provides prototypes to various customers in the B2B market.

The company currently has investment programs of Research and Development funded by Italian Ministry of Industry (**MISE**), Italian Ministry of Research (**MIUR**) and **Campania Region** in partnership with large companies. Currently, Youbiquo is involved in several European projects within the Horizon 2020 program together with international research centers and companies as Thales and Microchip.

The company has been awarded with two “Seal of Excellence” certificates by the EU Commission and has been granted for several R&D Programs by the European Community.

Youbiquo also provides consulting services for the design and prototype of wearable electronic and IoT devices, equipped with software applications. Smart features on board of our wearable/IoT devices are driven by Augmented Reality and Machine Learning technologies – i.e., understanding of Natural Language and Object Detection and Tracking.

The team consists of 15 employees skilled in software development, electronics design and prototyping, and mechanical product design. Governance is guaranteed by a board of two experienced founders.

The company boosts collaborations with Universities and Research Centres and has taken part to several international acceleration programs in which it was selected.

4.3.6.2 Identification of opportunities

The introduction of AR in the enterprise was mainly focused on marketing and engineering activities since 2017; later, maintenance was the main focus of use case in Industry; more recently, the introduction on assembly lines was tested, but limitation in precision of superimposing virtual content in Augmented Reality to real world rose up, as well as ability to measure and recognise objects in the field of view. These limitations showcased by all commercial AR headsets have to be overcame to widely apply AR technologies on assembly lines and, further, on quality inspection procedures. We have focused our research on the following

Quality Assurance problems and limitations: a) Detect defect on production line too late; b) Fixed detection points on production lines; c) High cost of fixed cameras.

Within OPTIMAI project we are building up a brand-new model of AR Smart Glass - integrating advanced metrology sensors and proprietary IP technologies to perform AR combined with high precision measurements of objects and close environment with the aim of increasing worker performances, effectiveness and safety in quality inspection activities. These advanced features are not yet available on AR devices on the market and will allow to foster market opportunities and positioning of the company in AR devices market.

4.3.6.3 Addressable Market

The global AR market is projected to reach USD 344,325 million by 2026, from USD 25,248 million in 2019 and is anticipated to register a CAGR of 42.5% between 2020 and 2026. The largest market segment based on component is the hardware, that will reach USD 2,02,929 million by 2026, from USD 14,195 million in 2019 and is anticipated to register a CAGR of 43.4% between 2020 and 2026. The largest market segment from the display point of view is the Head Mounted Display, that will reach USD 2,45,091 million by 2026, from USD 16,929 million in 2019 and is anticipated to register a CAGR of 43.7% between 2020 and 2026.

The largest market segment from the application point of view is the smart manufacturing industry that will reach USD 96,013 million by 2026, from USD 7,510 million in 2019 and is anticipated to register a CAGR of 47.2% between 2020 and 2026.By application, healthcare will be a key growth market segment. It is anticipated to register a CAGR of 47.2% between 2020 and 2026. By region, the Asia Pacific market segment is anticipated to register a CAGR of 46.5% between 2020 and 2026.

Our 2020 device Talens Holo is especially focused on Enterprise maintenance and assembly, allowing Operation specialists to assist remotely on-field operators in assistance and repair operations. This activity increased in importance during the Covid-19 pandemic, for the limited possibilities of local operation.

The planned release of AR Smart Glass for OPTIMAI project, thanks to advanced measurements features, will cover use cases in Quality inspection along production lines, reducing the time to detect and time to resolve, increasing productivity in manufacturing, ensuring increased precision at millimetric scale to operate with AR superimposing digital content to real world within Field of View; the device could be also applied to other vertical industries and sector, such as Medical Surgery, Construction and Manufacturing. Large and Mid sized manufacturing industries are the main target customers; hospitals and the surgery sector are a second vertical interested to the innovation.

The use of wearable smart cameras of which the AR smart Glasses are equipped will allow advanced features to be available also in a future work environment where robot and humans will collaborate, in order to increase safety in human-robot interaction.

4.3.6.4 Value propositions

AR Smart Glass combines AR with Machine Learning and Computer Vision through depth camera to allow precise measurement for quality assurance activities and zero-defect inspection in smart manufacturing.

The outcome of the project – AR Smart Glass prototypes allowing advanced and intuitive mixed reality interaction with virtual objects and content and, optionally, precise measuring of close objects - will be the background to build up and industrialise two models of AR Smart Glass devices, one focused on Quality inspection and another model customised for the healthcare and surgery use case. Actions will be taken to protect intellectual properties related to UX and gesture interactions detection and tracking algorithms combined with AI cameras. These actions will allow the commercialisation of software libraries independently from the AR Smart Glass sales. At the end of the project, a Marketing Plan and a Business Plan will be defined to exploit either the device and the software libraries offering in the Industry and in Medical sectors.

4.3.7 University of Thessaly (UTH)

4.3.7.1 Partner Profile

The UTH team is comprised of key individual researchers whose field of expertise is AI along with the development of AI models and methodologies. They also focus on other efficient AI techniques such as deep learning and fuzzy cognitive maps. They possess an extensive experience in AI algorithms and tools, intelligent decision support systems as well as in Learning Analytics and Big Data, which constitute significant components in all stages of the OPTIMAI project.

The research group behind UTH offers its valuable expertise in working with dynamical models for decision support systems, based on fuzzy cognitive maps, artificial intelligence methods and tools, machine learning, deep learning and data mining, to develop certain software components for the identification of defective products using artificial intelligence. Additionally, our organization exhibits long, solid experience in the AI framework in several European projects so far, constituting overall an ideal partner who can help OPTIMAI successfully deliver its outcomes.

4.3.7.2 Identification of opportunities

As part of the Integrated OPTIMAI Solution, AI methodologies for defect detection and prediction is one of the most important exploitable results that OPTIMAI will provide, regarding the optimal decisions for zero-defect manufacturing, optimal production planning and rapid and efficient re-configuration of industrial equipment. These results are intended to be effectively converted from pilot applications into commercial products with reasonable costs and configuration effort.

In this direction, UTH has established an individual exploitation plan, in which new competences in the field of AI models for defect detection, as included in the DSS system, will be developed through the implementation of the AI framework. More specifically, Artificial Intelligence methodologies will be developed for zero defect manufacturing through the analysis of multisensorial quality inspection data, the detection of defects and the identification of defects' causes upstream in the manufacturing process. In turn, AI-enabled quality inspection will provide feedback and readjust production parameters to improve quality and optimize production.

Hence, UTH's exploitation plan is first to protect the knowledge created in the course of the project, in the form of the innovative developed software, by licencing the final production application, which can address the challenge of AI models for Zero-Defect Manufacturing. UTH has the opportunity to own the foreground it generates which is defined by the Knowledge and Intellectual Property Rights within OPTIMAI, to manufacture and sell the produced software within a defined market area.

Moreover, an Indirect exploitation can be realised by working with relevant project partners to develop application demonstrators partly based on UTH's research output, which is the development of AI methodologies for defect detection and prediction. UTH can break into the "intelligent" market with the demonstration of the AI Production Monitoring Component which offers certain capabilities such as profiling, indexing and repurposing defective parts and is related to OPTIMAI's objective of developing AI models and algorithms for quality inspection. In particular, the produced component will be utilized as a site use case for KLEEMAN, Microsemi and TELEVES end-users for quality control and defect detection in the manufacturing process. This exploitation attempt will increase UTH's wider outreach opportunities both in Europe and globally.

4.3.7.3 Addressable Market

There is a strong consensus that target customers that belong to manufacturing industries have the need to achieve zero-defect manufacturing, reduction of risk, a clear overview of the cost of operations in real-time, and overall performance optimisation within the manufacturing process. In this direction, OPTIMAI can offer a unique solution through the integrated results that delivers for quality control, early defect detection and prediction for zero-defect manufacturing.

To begin with, the OPTIMAI solution could be put in the market in the form of an integrated solution or in the form of individual of Result(s) to be sold:

1. directly to enterprises (end-users) belonging to the **industrial manufacturing sector**,
2. to companies that implement **quality inspection** and **monitoring systems** and/or communities in the field of **maintenance management**, as part of the smart manufacturing sector,
3. to technology providers such as **software industries, ICT research communities, engineers** and the **scientific community**.

As regards UTH, its direct target audience includes research teams and other R&D industrial groups, which can exploit directly and indirectly the project's results. The developed AI methodology will help these target groups to further understand and expand the relevant machine-intelligence research that has a direct impact on society and industry. They will also benefit from a possible dynamic collaboration with UTH and from the exploitation of the produced AI models and algorithms in the field of quality inspection and monitoring in manufacturing.

Moreover, UTH can offer highly innovative insights into how either external manufacturers or industrial partners can scale AI, with important implications for defect detection in the

manufacturing process. These companies will be able to integrate AI into their firms, leveraging AI in the form of new capabilities and improving the overall manufacturing process. AI capabilities can play an important role in monitoring product flows, defected products, and maintenance processes. Overall, the effects of the produced AI methodology go beyond incremental process improvement and include fundamentally new ways of operating and growing a business.

4.3.7.4 Value propositions

UTH's production AI framework:

- Delivers a holistic and innovative solution for zero-defect manufacturing, predictive maintenance, optimal production planning, automated quality control and production monitoring.
- Utilizes state-of-the art AI techniques and algorithms for early detection of deterioration in production and prediction of upcoming defects.
- Reduces production costs, energy & material consumption.
- Increases overall quality and customer satisfaction.

4.3.8 Engineering Ingegneria Informatica S.p.A (ENG)

4.3.8.1 Partner Profile

Engineering (ENG) is Italy's largest systems integration company. With approximately 12,000 professionals in 40+ locations (in Italy, Belgium, Germany, Norway, Serbia, Spain, Switzerland, Sweden, Argentina, Brazil, Mexico and the USA), the Engineering Group designs, develops, and manages innovative solutions for the areas of business where digitalisation generates major change, such as digital finance, smart government & e-health, augmented cities, digital industry, smart energy & utilities, and digital media & communication. The greater performance of Engineering in the Industry and Services segment is due to the ability to combine twenty years' experience with the potential offered by technologies such as Cloud, Artificial Intelligence, Digital Twin, Digital Enabler, IoT, Cybersecurity, and Big Data.

The R&D lab, founded in 1987, with 250 researchers has participated in more than 100 EU funded projects and gained international research awards.

Engineering has also a long-standing expertise in Industry and a strong focus on R&I projects, where it has shown the capacity of exploiting research results. In fact, ENG is also very active in many key international initiatives and activities including NESSI (Networked European Software and Service Initiative), founding partner of the Future Internet PPP initiative, FIWARE. ENG is corporate member of OW2 Consortium and Eclipse Foundation. It is also involved in other related projects where it has the opportunity to network and interact with major research and business players.

4.3.8.2 Identification of opportunities

Engineering is strongly interested in committing to joint initiatives with other project partners, to further exploit the OPTIMAI results in the future. ENG's commitment pertains to all relevant Exploitable results which fit into the common exploitation strategy, where it can provide its

expertise - both internally and externally to the project - as well as utilizing its market leadership and innovation management capability.

Additionally, Engineering operates within strong strategic networks and initiatives, comprising leading industries, Future Internet initiatives, etc. where it can further disseminate and promote OPTIMAI.

4.3.8.3 Addressable Market

ENG expects to increase its capability of **offering innovative solutions** to its clients, especially in the **manufacturing domain**, by utilizing OPTIMAI results and possibly expanding its current services portfolio.

Moreover, ENG will promote project results through several communities in which it is involved such as FIWARE, BDVA/DAIRO, IDSA, Digital Factory Alliance to increase the visibility and the awareness of the project through the technical community.

Internally ENG's R&D department will transfer technologies and knowledge acquired from its involvement in the project to ENG's own **Industry & Services business unit.**

4.3.8.4 Value propositions

ENG will use the project outcomes in order to identify and address the new and emerging key clients' needs and to strengthen its presence in the industry sector. In addition to that, ENG is also interested in the potential **re-use and adaptation** of some innovative technologies being researched and developed in the project.

As a founding member, ENG will spread OPTIMAI platform and services through the **Digital Factory Alliance**, a global initiative with a factory focused mission able to reach manufacturing companies all over Europe.

Internally, ENG will exploit OPTIMAI results through its own **innovation pipeline**, where research results are presented internally to relevant **business units** for further development and possible integration in the business portfolio.

Furthermore, ENG will promote and exploit OPTIMAI project and outcomes through dedicated commercial activities supported by corporate **marketing** and **communication units**.

4.3.9 Unimetrik S.A. (UNIMET)

4.3.9.1 Partner Profile

Unimetrik is a Metrology Service company and a Calibration Laboratory, oriented to offer solutions for the industry related to Calibration, Measurement and Metrology Engineering; certified in: 1) ISO 10012, which specifies generic requirements and provides guidance for the management of measurement processes and metrological confirmation of the measuring equipment used to support and demonstrate compliance with metrology requirements. 2) ENAC: Dimension, Temperature and Torc Certification. Utilising the latest technology and with

highly qualified staff, Unimetrik, our ENAC-accredited laboratory, is able to guarantee maximum service rigour and reliability.

In Unimetrik, innovating is the way to improve the services that we offer to our customers, as innovation and research allow us to find solutions to existing or potential problems in the industry. Thus, we place special emphasis on innovation and R&D activities to research new processes, new methodologies and tools relating to 3D Vision, optics, electronics, metrology and software engineering. In this sense, Unimetrik have collaborated in European R&D projects such as, EASYTRACK, MT CHECK, e-Calibra and ADALAM, this last as the project coordinator.

Unimetrik will bring to the project its expertise in metrology, calibration and dimensional quality control assurance, making available their advanced facilities with the most accurate systems for verification of parts/tools and advanced metrology software, for a characterization and evaluation of measurement solutions as well as its calibration and certification. This involves the identification of error sources, their effects on the machine, measurement processes, and the development of specialized calibration artifacts and methodologies. Additionally, Unimetrik will lead the task related to IPR protection for the exploitable assets that result from the project.

4.3.9.2 Identification of opportunities

UNIMET will use the results of the project to expand its catalogue of solutions by adding the measurement, verification and calibration methodologies and processes developed in the OPTIMAI along with more use cases where our technology is applicable. Moreover, the experience and know-how gained work for updating and improving the already existing products, services and techniques. Quality control and ZDM are important paradigms for most clients so this project will improve UNIMET position in the Metrological Engineering market in Spain and Europe.

4.3.9.3 Addressable Market

UNIMET is acknowledged by the principal aeronautic groups in Spain and it is exporting its technology to countries such as USA, Germany, Brazil and the Czech Republic. These form part of the target markets in where Unimetrik would like to continue expanding, as well as in other countries of Europe; mainly in the fields of industrial manufacturing such as automotive, aeronautics, constructions, utility, electronics, etc. On the other hand, effective quality control processes are highly important and demanded in the new manufacturing paradigm of Industry 4.0 as they provide key information, real time corrections, more productivity and reduced production times. In this sense, by increasing our knowledge, experience and developments in projects such as OPTIMAI help us to cover more and more end users' needs, from different manufacturing production lines.

4.3.9.4 Value propositions

As commented, project results will contribute to improve the developments of UNIMETRIK standard products. UNIMET will focus on delivering the OPTIMAI's results to its industrial clients, showing them how the solution could apply or improve their operations, based on their particular manufacturing process characteristics. Indirect exploitation may be realised by assuming UNIMET as a reference in the industrial IT world. Our project results dissemination plan is focused on UNIMET participation in industry-related conferences, and similar events,

located both in Europe as well as in other continents. Most of these events are focused on metrology, quality and other industrial sectors as metal and mechatronics, interested in quality control and precision manufacturing. Additionally, UNIMET will disseminate OPTIMAI results in its website and in events such as EMO, CONTROL, METROMEET, Measurement World & CIM International Metrology Congress, FabTech, EXPOMAQ, IMTS.

4.3.10 Universitat Politècnica de València (UPV)

4.3.10.1 Partner Profile

Universitat Politècnica de València (UPV) is a dynamic, innovative, public institution, dedicated to research and teaching that keeps strong ties with the social environment in which its activities are performed and, simultaneously, has an important presence abroad. Today, over 39,000 members integrate its academic community: 35,000 of these are students, 2,387 are teachers and 1,593 belong to administration. UPV includes 15 faculty centres: ten schools, three faculties, and two higher polytechnic schools (Alcoy and Gandia), and five associated institutions.

The UPV is a non-profit academic and research-oriented institution, whose main objectives are two-fold: i) to provide the whole of society with a continuously updated high quality superior education and ii) promote high quality research as an outstanding aspect to obtain recognition from society, the business sector and finally from students.

4.3.10.2 Identification of opportunities

Currently, many universities educational programmes are outdated. This is because in recent years there have been great advances in technology, and it takes time to transfer these advances to the university academic and formative curricula. Consequently, in many educational programme's technology is ahead of what is taught in the classroom. Furthermore, on many occasions the knowledge that is transmitted is largely theoretical and with few final applications. The updating of subjects with practical and current applications of cutting-edge technologies allows students to stand out when they enter the highly specialized and competitive labour market.

As explained previously, the UPV is a non-profit academic and research-oriented institution whose main clients are its students. The UPV provides a response to the need of providing to its students a high-level education that is as up to date as possible with current market demands. The participation of the UPV in OPTIMAI allows the university to validate its research results and its developed solutions in a real industrial environment with final users. This knowledge is translated to the academic curriculum by the professors and researchers who participate in the project, translating in the lectures the real needs of industry and thus going beyond a purely theoretical framework. The knowledge gained will be made available to students, and the whole society, through courses, master's, and doctoral programmes.

4.3.10.3 Addressable Market

Education is one of the main assets of a society and must play an active and proactive role. It is a service that must be permanently updated to the diverse requirements of a society, responding to the needs of the business and economic environment of the country and the

region. Thus, universities aim to design high quality academic programmes and provide greater benefits that add value to the different target audiences, in order to attract and retain their customers, the students.

Zapata (2007) states that educational institutions have been growing for many years, thanks to the inertia of an uncompetitive market. The situation they face today, both in Colombia and in the rest of the world, is very different. The strong and intense competition they have to face forces to respond to a demanding demand, with innovative proposals, adjusted to the needs of the market to which their educational offers are directed. Therefore, there are a number of changes and challenges that Higher Education Institutions have to face.

On this line, Pérez (2002) considers in his research that the market for the generation and dissemination of knowledge is currently highly competitive, the criteria for selecting alternatives are very subjective, and the culture of the right to choose on the basis of relevant information is very strong. It is evident that the situation is different from 20 years ago, when there was not so much education on offer at higher education level, changes in the market structure can be observed, and universities must adapt to these changes, offering effective responses to the needs and desires of their target market. On the other hand, Carmelo and Puelles (2007) state that if the university does not project a quality academic image, it will not be able to obtain resources from the productive sector or other possible sources of funding.

Hence, in recent years, universities have made a great effort to project a strong image and offer an appropriate educational programme, at a price that students and their families are willing and able to pay, in a reasonably attractive location. All these aspects are communicated to prospective students in an accurate, interesting and timely manner. Universities know very well what the consumers of higher education programs need and want, since they have concrete and specific demands, being aware that they have more and more information on the variables currently provided by the educational market. Currently there is a struggle to capture very strong markets with costs for all tastes. An "average" service at a low price is not enough, as stated by Ramírez (2009).

4.3.10.4 Value propositions

UPV as a non-profit public university aims to engage students. One important channel for UPV is to reach out to potential students and general society with presence in the media channels and social media. The research results from the project will flow into the academic curricula by endorsing solutions and paradigms related to OPTIMAI research in teaching programs. The knowledge acquired will be made available to society through courses, master's, seminars and doctorate plans. Specifically, Component-based Software Development and modern Distributed Systems lectures can be given during postgraduate semester programs to inspire students towards the design of OPTIMAI solution while advanced research concepts can be incorporated to respective doctoral courses. These lectures will allow both, to generating fruitful debates and interesting ideas as well as allowing the student to know areas and opportunities in it in which to actively participate in the UPV, in addition to put researchers and potential talents in contact for innovation projects.

Another area in which it will be impacted significantly will be the scientific community, through conference, workshops and international journals related with the research areas addressed by OPTIMAI. Thus, UPV plans the exploitation of OPTIMAI results to further increase their standings and ranking in the academic area through participation to key scientific conferences and journals.

Participation in the project will generate localized knowledge for the university in both technological (AI, advanced IoT systems, digital twins) and business areas (better diagnosis, thanks to the application of AI and always under the supervision of expert personnel). In this way, the university's competitiveness is increased, thus facilitating the export of knowledge as a service (either through new competitive projects, creation of courses and masters, sale of services, etc.).

Finally, in the field of research, new projects generate subsequent ones in which knowledge is consolidated, updated and improved, providing feedback on the return chain in the social field in a way analogous to the economic field (the first more for universities and research centres, the second for companies).

4.3.11 Carr Communications Ltd (CARR)

4.3.11.1 Partner Profile

Carr Communications is predominantly a service-based company that focuses on PR, Communications Management and Human-Resource Training. This results in a slight difference in exploitation strategy from the partners that have concrete products developed through the project. CARR will be using the OPTIMAI exploitable results to improve on their current services and expand them to the manufacturing market. This will be done by using the knowledge gained from our participation in the OPTIMAI project, as well as the networks developed in the manufacturing and production process design sectors. In the following section, we will briefly explore the products that CARR plans to take to market using OPTIMAI exploitable results.

4.3.11.2 Identification of opportunities

Market R&D: An important service that CARR provides is market research on PR, Communications and Marketing Strategies. By exploiting the new networks and connections created by our experience working on a manufacturing-oriented project, we expect to increase our yearly work in Research and Stakeholder Engagement. This will be achieved by using our experience in the sector, as well as our communications strategies to reach new clients in the industrial domain.

Training Programmes: Similarly, CARR will be incorporating best practices learned from our experiences in OPTIMAI to update the content in our personnel training programmes and increase their relevance to the manufacturing industry. These training programmes are often booked by corporate offices for large groups to improve the overall capabilities of the team.

Communications Strategy: In addition to these services, CARR provides a number of Communications Service and Strategy Workshops. We will be using our experiences to develop updated programmes aimed at the industrial sector, with workshops focusing on Industrial

Communications Strategies and the Practical Application of Behavioural Economics in Manufacturing. In addition to this, we also provide communications services such as Communications Strategy and Planning Development, Online Marketing, Media Strategies, and Sponsorship Strategy Services.

Event Management Service: CARR also provides an Event Management service, which could be marketed to the industrial sector for exhibitions, demo sessions, conferences, brokerage events or trade fairs.

Design Services: An additional avenue for possible future exploitation is in the design of products through CARR's graphic design department. Currently CARR produces various design services including general Branding and Promotional Materials. In addition, website design services are also provided. Using our experience in producing these as part of the project,

CARR can use their experience to target the manufacturing sector and leverage the strategies and best-practices learnt in OPTIMAI.

Participation in New Research and Innovation Projects: A major route for the post-project exploitation of results will be the participation in a new EU funded research and innovation project. CARR has several pieces of intellectual property developed as part of the project, as well as extensive experience in communications, dissemination and exploitation strategies. By using this experience and the contacts developed throughout the life of the project, CARR will approach potential partners and begin drafting project proposals based on similar topics to OPTIMAI.

Impact Evaluation & Assessment: Finally, CARR provides a service in which it conducts analysis of the impact achieved by a communications strategy. This allows companies and projects to identify the gains from various marketing and communications strategies and then refine them to maximise their effectiveness. This is a service which could be applied to a number of the products and services listed above.

4.3.11.3 Addressable Market

Target audiences include:

- manufacturing companies
- industrial projects
- industrial research groups
- regulators
- policy makers
- researchers, academics, students

4.3.11.4 Value propositions

Expansion of existing services: opportunity to expand our market offerings in communication and dissemination services to a number of key manufacturing areas. In addition, the knowledge of CARR's involvement in OPTIMAI will be important as CARR seek to expand their market penetration in these activities.

Future R&D opportunities: Furthermore, CARR sees the potential to be involved in future related R&D projects through their involvement in the OPTIMAI project. Working relationships developed with project partners and wider networks may lead to future collaboration and continuation of the results achieved in the OPTIMAI project.

Potential for a Spin off/ Start-up business: The IP developed in OPTIMAI could be utilised (in an agreed way) to facilitate the development of new businesses, and CARR could be part of such developments.

4.3.12 Universitat Autònoma de Barcelona Institute of Law and Technology (UAB-IDT)

4.3.12.1 Partner Profile

The UAB Institute of Law and Technology (UAB), housed at the Faculty of Law, is a research centre promoting cutting-edge research on Law and Technology from an interdisciplinary perspective (http://idt.uab.cat).

The areas of research include Law and Artificial Intelligence, legal culture and judicial studies, alternative dispute resolution (ADR) and online dispute resolution (ODR), legal ontologies, the Semantic Web, Data Protection, Ethics and regulations for the Web of Data. The UAB team role entails: (i) setting the normative requirements for the project approach; (ii) building the regulative model for the technologies and platform deployed in the project and the workflow of data; (iii) carrying out the knowledge acquisition process; (iv) fleshing out the governance and ethical principles for the whole system; (v) guiding Consortium partners in data protection issues to promote data protection compliance with the GDPR: (vi) linking the project with the monitoring tasks of the project's Ethics Board all along lifecycle of the project; and (vii) providing interoperability among different European countries through semantics. UAB researchers are also able to contribute significantly to the organization of specialized Workshops, and the dissemination of the project findings and results through scientific publications and presentations in the main Data Protection and Law & Technology Conferences and Workshops (EDPD, EDPP, IVR, Jurix, ICAIL, AICOL).

The UAB has contributed to large projects in FP7 and H2020 programmes. As Ethical and Legal partner: CAPER (2011-2014) with GA 261712; TAKEDOWN (2016-2019) with GA 700688; SPIRIT (2019-2021) with GA 786993; and ITFLOWS (2020-2023) with GA 882986.

The UAB's role in OPTIMAI project is mainly focused on the Legal and Ethical framework (WP9). The main objectives of this WP are: (a) to identify the EU ethical and legal framework applicable to the project with the aim of ensuring that the innovation brought by OPTIMAI is lawful, ethical and social desirable; (b) to identify the potential risks posed by the foreseen research activities from an ethical, legal and social perspective; (c) to provide the OPTIMAI regulatory model; (d) to set up a monitoring and enforcement strategy to ensure that the outcomes of the project comply with the legal and ethical requirements and societal values previously identified for OPTIMAI; and (e) to provide continuous legal and ethical advice and support to the OPTIMAI Consortium.

4.3.12.2 Identification of opportunities

The UAB enrolment into the H2020 programme was mainly focused on "fight against organized crime and terrorism" topic. Therefore, the UAB participation in OPTIMAI has largely contributed to include "Industry 4.0" field in our catalogue of expertise. The inclusion of the "Industry 4.0" particularities to our know-how opens a new opportunity to be part of new consortium in the Horizon 21 programme in industry related calls.

4.3.12.3 Addressable Market

Our target is two-fold. Firstly, the UAB as higher education establishment, public body and non-profit organization focuses on the academic field, then, we expect to publish in outstanding peer-reviewed journals and relevant academic events. Secondly, the know-how acquired will enable our participation in consortiums related to the industry field.

4.3.12.4 Value propositions

The know-how acquired through the OPTIMAI project will include improve the methodology used to develop ethical and legal strategies and to monitor activities from a legal and ethical perspective. This improvement in our methodology will be disseminated through the OPTIMAI project and our institution dissemination and communication channels and, also, through the academic publications produced. In addition, we are also gathering relevant events and fairs related to industry in order to create a strategy to promote our expertise and methodology. The main idea is to use this knowledge to achieve a better position for the Horizon 21 programme.

4.3.13 Trilateral Research Ltd (TRI)

4.3.13.1 Partner Profile

Trilateral Research (TRI) is an Ireland-based SME. It specialises in research and the provision of policy, regulatory and certification advice and recommendations for new technologies, processes, policies and systems. Trilateral has a long record of successful project involvement on the privacy, social, ethical, and legal impacts of new data practices and innovation. We have expertise in assessing impacts and risks, and evaluating systems to suggest solutions to enhance innovation whilst ensuring responsible practices. We have been working with the new General Data Protection Regulation (GDPR) since the first drafts in 2011, and we have GDPR certified research analysts experienced in Data Protection Impact Assessments and helping to support the implementation of the GDPR. We regularly work with a variety of stakeholders ranging from technical specialists, policy-makers and citizen groups in order to contextualise this work. In addition, Trilateral designs, develops and evaluates data analytics tools with a special focus on transforming data into actionable information for industrial, institutional and policy stakeholders. This technical competence informs our privacy and data protection work, to ensure a complementarity between social science and technical expertise across all our activities. Trilateral leads the privacy and ethical impact assessment work for multiple H2020 projects (e.g., HEROES, DARLENE, PestNU, TechEthos, TRIPS).

Name and Description of the Department(s) contributing to the execution of the Project:

The policy, ethics and emerging Technologies (POET) team focuses on assessing the ethical, legal and social impact of new technologies providing guidance for policy-makers while identifying new promising technology trends. POET team consists of social scientists, ethical and legal

experts. The team's research impacts on a wide variety of disciplines, all focused on enhancing societal well-being, including (but not limited to) new and emerging technology, ethics of technology, responsible research and innovation (RRI) and human rights. POET team works with stakeholders at national, European and international levels having an expertise on primary applied research, impact assessments (ethical, socio-economic, privacy, and human rights) and stakeholder engagement. POET team has over 15 years' experience of leading and participating in European and nationally funded research projects.

4.3.13.2 Identification of opportunities

A description of the way OPTIMAI project results and outcomes are relevant to improve each partner business and activities, gaining a better positioning in the markets/areas of action or opening new possibilities in different ones.

- An **integrated impact assessment methodology** encompassing ethical, legal (including human rights and privacy) and societal aspects that focusses on the entire lifecycle of the research and innovation process, including TRI Risk Touch Point Table™ (D7.3; D9.2; D9.3; D9.4; D9.9).
- The Trilateral's integrated impact assessment methodology follows the ensuing path:
    a) identification of the ethical and legal framework together with mapping ethical and legal requirements.
    b) mapping ethical, legal, and societal aspects of the research and innovation (R&I) process and its outcomes, thus for two layers: (1) R&I activities; (2) R&I outcomes – technology. Such aspects are identified in collaboration with internal and external stakeholders, including tech developers, end-users, Ethics Board (EB) and other relevant stakeholders.
    c) requirements, ethical, legal and societal (ELS) aspects, principles and values are translated into specific solutions, actions and mitigations measures via dialogue sessions with relevant stakeholders.
    d) tech developments are assessed, monitored, and re-evaluated following the R&I process in an iterative and agile way.
    e) the final integrated impact assessment providing recommendations for potential use of the project's results.

4.3.13.3 Addressable Market

Target audiences for Scientific Partners are, i.e. research teams, students, general public, R&D industrial groups, etc, for industrial partners It can be internal (the own organization), external (potential customers) or a mixture of both. Where OPTIMAI can be applied and how, identifying what kind of needs customers have or what kind of expectations the solution needs to fulfil.

Scope: (connect result with the scope)

- Manufacturing technology is developed to strengthening competitiveness and growth of companies, improve quality, optimize production, boost productivity and environmental sustainability. However, technology may also (even with best intentions) lead to breach

of legal compliance, ethical and societal values, particularly in the context of corporate social responsibility (CSR), sustainability and employees rights.
- Manufactuing technology needs to be assessed in terms of its impact on society and environment (ethical, legal, societal and environmental aspects of tech).

Customers (problem owners – they make our results sustainable):

- **Private sector: Private actors (tech companies)** developing tech supporting manufacturing may conduct impact assessment internally or engage external advisors. Not always a top priority, no means, etc. **The impact assessment is rarely independent** when conducted internally by tech developers. At the same time, it should be outsourced from the tech developing partners, to guarantee independent review. This may lead to lack of trust from potential clients, breach of legal compliance, ethical and societal values.
- **Private sector: Private actors (manufacturing companies) have limited or no support regarding ethical, legal and societal aspects of tech solutions**. Occasional data protection officers, legal/CSR advisors, HR officers are often disconnected from research and innovation (R&I). This may lead to negative consequences for manufacturing companies such as lack of trust from employees, breach of legal compliance, ethical and societal values, risk to reputation among partners and clients.

Impact assessment methods:

- **Most current technology and impact assessment methods** either engage in ex-ante assessment (based on hypothetical design) or ex-post assessment (based on the finalised prototype), which makes them either **not extensive and specific enough, or associated with large costs to redesign and redevelop an existing solution to comply with the ethical and legal requirements.**
- **Impact assessment often focuses on only one type of consequences**, e.g., privacy, health, or societal aspects and it is not balanced with severity, likelihood and occurrence. Rarely does such impact assessment focuses on technology assessment, no understanding of specificities of tech.
- **The integrated impact assessment is hardly part in a design process**, going beyond abstract principles, applying them to the specific design – development – and use decisions to be taken. The assessment is often shaped as an ex-post justification.
- The **impact assessment is rarely transdisciplinary** (lack of understanding between social sciences and humanities and engineering).

4.3.13.4 Value propositions

Unique Selling Point USP - Unique Value Proposition UVP:

- **Integrated approach to the impact assessment**, encompassing ethical, legal (including human rights and privacy) and societal aspects that focusses on process and product assessment.
- **Tailor-made and adapted** to specific context, new and emerging technology, partner/client.
- **Ethical, legal and societal aspects:**
    - **continuously updated;**

    - **expanded** to include all relevant international, European norms and standards relevant to security research projects (RIA);
    - **operationalised over multiple projects** to make their assessment close to practical decisions and the abstract normative framework close to the design decision level.
- **Continuous feedback** between design proposal – ethical, legal and societal (ELS) review – design update, to prevent resource extensive revisions at a late development stage (agile approach).
- Process (**responsibility-by-design**).
- High **reliability of solutions and transferability between projects and technologies**, while a specific contextualisation (of national legal provisions) can be modularly adopted.
- **Transdisciplinary approach to implementation of responsible research and innovation (RRI) in practice**.
- The assessment aims at recommendations for integration in the design.

4.3.14 Kleemann Hellas S.A. (KLEEMANN)

4.3.14.1 Partner Profile

Founded in 1983 in Kilkis, Greece, KLEEMANN is one of the most important lift companies in the European and global market, providing any type of residential or commercial passenger and freight lifts, escalators, moving walks, accessibility and marine solutions, parking systems and lift components. Its distribution network expands to more than 100 countries.

KLEEMANN stands for innovation in design and technology, for flexibility and breakthrough thinking, for quality products and dedicated services and support.

Integrated manufacturing facilities, highly trained workforce, state-of-the-art IT systems and logistics support enable KLEEMANN to deliver reliable, highly personalised solutions.

Installation and maintenance companies handle the distribution of the company's products all over the world. Fine-tuned collaboration between management teams, employees and other involved parties allows KLEEMANN to build and maintain strong, long-term relationships with its customers and provide reliable services across the globe. The company's strategic approach and investments have enabled the specialised manufacture and export of products into multiple markets, developing global networks, international presence and product range.

KLEEMANN is proud of its strong global brand name, consistent with its commitment for quality standards, progressive technical and market knowledge and innovative research schemes.

In the OPTIMAI project, KLEEMANN is participating as a pilot partner. The developed OPTIMAI solutions will be deployed in the company's hydraulic lift plant and more specifically in the power unit's testing lab. The ultimate goal of the pilot testing is to automate quality inspection processes towards zero-defects, to provide optimal calibration in the production line and to improve overall production planning. Apart from being one of the main pilots of OPTIMAI, KLEEMANN is responsible for the identification of user requirements and the definition of the OPTIMAI use-cases.

4.3.14.2 Identification of opportunities

The developed OPTIMAI tools are expected to support the decision-making regarding the quality monitoring and recalibration processes towards zero-defect manufacturing. KLEEMANN is planning to use the OPTIMAI solutions both in a commercial and in a non-commercial basis. In a commercial basis KLEEMANN will promote the offerings and benefits of the tools in its close partner network and will support the application and deployment of the solutions. In a non-commercial basis KLEEMANN is aiming to expand the OPTIMAI solutions in the whole group, starting from the European facilities (Serbia). The OPTIMAI tools and technologies will be used only under specific commercial agreements with OPTIMAI's technical providers.

4.3.14.3 Addressable Market

KLEEMANN, as a large enterprise of the lift industry in the European and global market, will focus on the exploitation of OPTIMAI's results both internally and externally. KLEEMANN identifies internal and external potential customers and targeted internal and external stakeholders.

- Internal customers include other shop floors, departments of the same factory or other production lines and manufacturing facilities of the Group around the world (Serbia and China).
- External customers include machine suppliers, technical and commercial elevator companies, elevator installers, maintenance providers and research institutes.

4.3.14.4 Value propositions

As one of the major lift manufacturers worldwide, KLEEMANN expects that the OPTIMAI solutions, will attract the interest of internal and external stakeholders and will initiate new collaborations with research, technology and industrial partners towards technology transfer and commercialisation.

4.3.15 Televes S.A.U. (TVES)

4.3.15.1 Partner Profile

Televes is a leading global company focused on the design, development and manufacture of Telecommunications and IT products and solutions for building, smart cities, hospitality and home infrastructures, that will enable all present and future services.

Founded in 1958, the company is headquartered in Santiago de Compostela (Spain), where it keeps its state-of-the-art manufacturing facilities. A key signature trade of the company, Televes believes in delivering superior quality products through an exquisite manufacturing process.

Nowadays Televes is much more than a leading brand. It is the head of a corporation comprised of strategic technological firms with a commercial presence in more than 100 countries. Televes is formed by 21 industrial and services subsidiaries, over 700 employees and holds more than 200 Industrial Property registers (European Patents, National Patents and Utility Models).

With nearly 60 years of experience, Televes has launched more than 1,500 different products, an achievement explained by the authentic passion for manufacturing. The company manufactures in its own facilities to guarantee maximum quality. It's also a pioneer in setting up

4.0 production lines with its own certification and quality control laboratories. In this way, our products proudly display the European Technology Made in Europe label.

European Technology Made in Europe:

At the beginning, as a pioneering company in the production of equipment to receive the radio television signal, Televes was forced to develop and manufacture most of the components of its products. This need for self-sufficiency led to one of the virtues that distinguish the company today. A passion for manufacturing. When most companies in the sector opt to subcontract the manufacturing processes in search of cost savings, Televes continues loyal to its industrial tradition. Controlling the entire production process on its home turf, from the design to the manufacture, enables the company to develop the products more swiftly and with greater guarantees of quality and reliability, as well as protecting the intellectual capital developed. This is the conviction contained in the slogan 'European Technology Made in Europe', which the markets associate with the Televes name as a synonym for quality, reliability and avant-garde technology.

In the OPTIMAI project, Televes is participating as a pilot partner. We will deploy OPTIMAI solution in our Antenna manufacturing line. As it was reported in D2.6, The antenna manufacturing line was designed following a high-volume high mix approach. Therefore, it is key to deal with quick and reliable setups changes and parts failure detention at earlier as possible in the manufacturing process. This challenging environment provides an ideal testbed for implementing and evaluating OPTIMAI's use cases. The final objectives of our pilot are to identify, detect and optimise stoppages and/or incidents that affect production efficiency.

4.3.15.2 Identification of opportunities

We, as manufacturers, always try to manufacture quicker, cheaper and better products. In that sense, defined uses cases are oriented to reduce the number of defects, reduce the number of setups, increase the operative line time and do improved scheduling. In that sense, our expectations are to increase the number of antennas sells because of the promised benefits of OPTIMAI that will allow us to provide a better and cheaper product.

Therefore, Televes is aiming to extend the OPTIMAI solutions to all our factories and productions lines. The OPTIMAI tools and technologies will be used only under specific commercial agreements with OPTIMAI's technical providers.

4.3.15.3 Addressable Market

As previously mentioned, our exploitation of results will be to extend internally OPTIMAI to all our automatic manufacturing lines in our factories in Spain and Portugal.

4.3.15.4 Value propositions

Based on antenna line improved KPIs we will explore to extend its use to other manufacturing lines and also open new collaborations with research, technology and industrial partners towards technology transfer and commercialisation.

4.3.16 Microsemi Semiconductor Ltd (MTCL)

4.3.16.1 Partner Profile

Microchip Technology Caldicot Ltd (MTCL), is a wholly owned subsidiary of Microchip Technology Inc.

Microchip Technology Incorporated is a leading provider of smart, connected, and secure embedded control solutions. Its easy-to-use development tools and comprehensive product portfolio enable customers to create optimal designs, which reduce risk while lowering total system cost and time to market. The company's solutions serve more than 120,000 customers across the industrial, automotive, consumer, aerospace and defence, communications, and computing markets. Microchip is headquartered in Chandler, Arizona.

In the OPTIMAI project, Microchip Technology is participating as a pilot partner. The developed OPTIMAI solutions will be deployed in the company's die saw, routing and encapsulation processes. The ultimate goal of the pilot testing is to automate quality inspection processes towards zero-defects, to provide optimal calibration in the production line, reduce the time taken for these activities and improve overall production planning. Apart from being one of the main pilots of OPTIMAI, Microchip Technology Caldicot Ltd is responsible for the deployment of training materials and pilot trials of the OPTIMAI systems (WP7).

4.3.16.2 Identification of opportunities

Microchip Technology Ltd is an advanced electronics packaging facility and as such takes tested silicon wafers and processes them into complex high-cost electronic packages. The developed OPTIMAI tools are expected to support the decision-making regarding the quality monitoring and recalibration processes towards zero-defect manufacturing. During the OPTIMAI project Microchip Technology Ltd will look to use the OPTIMAI tools to replace or complement existing inspection methods. This in turn will reduce yield losses in the manufacturing process. Furthermore, a better understanding of the rejection rates for each criterion would be fed back into the manufacturing process to reduce waste.

Depending on successful trials at the Microchip Technology Caldicot Ltd site beyond the project the OPTIMAI tools and technologies will be used only under specific commercial agreements with OPTIMAI's technical providers.

4.3.16.3 Addressable Market

Microchip Technology Caldicot Ltd is a medium size business with multiple machines being used in the areas being targeted within the course of the project. This gives opportunities for further take up internally for the OPTIMAI solutions. Additionally, as a global business there is also the opportunity for take up of the system at other manufacturing sites around the globe.

4.3.16.4 Value propositions

As an end user of the OPTIMAI solution, Microchip Technology Caldicot Ltd will be focused on extracting the maximum benefit from the investments made within the project to drive down costs, improve productivity and further control quality within the manufacturing process.

4.4 Exploitation Strategy on Consortium Level

In this section, an initial analysis of a future Join Exploitation Plan will be outlined. Even though the project is in an early stage to define a Joint Exploitation the strategy for the exploitation of the project results was elaborated from the beginning, in collaboration with the dissemination and communication planning, to enable the most extensive use of the project outputs and the maximization of the project impacts. OPTIMAI partners are considering the scenario of joint exploitation of project results, the role of the partners in the joint exploitation strategy will be defined in the Mid Phase" with the support of the Exploitation Team by collecting partners' interest and involvement in the different possible joint exploitation activities.

At Consortium level, three main models are proposed and will be carefully considered in the Mid Stage, given the project nature and partners' characteristics, all of which have reportedly been successfully applied in other European IT research projects[5]. The three models are described hereafter, also highlighting the main pros and cons. Currently there is a preliminary discussion within the consortium and the final decision will only be taken towards the end of the project.

4.4.1 New Legal Entity

With this model, a new legal entity is created to manage the foreground generated and to pursue both commercial and non-commercial objectives of the OPTIMAI exploitation. This model foresees a strong centralized management (company-like) and typical roles covered by partners who would usually provide staff and resources. The creation of a legal entity tends to face a certain degree of legal and 'bureaucratic' difficulties, thus certainly timing can be long. It enables a strong implementation of the exploitation strategies and, once set-up, would prove rather stable. Partners could join with different roles (as partners, stakeholders, etc.) and various levels of commitment. It should be mentioned that joining a profit-making entity might not always be a viable solution for some partners (e.g. non-for-profit and research organizations), however, various solutions exist for their involvement. There exists a risk that creating a new legal entity might result in a too convoluted and resource- and time-consuming activity. Additionally, the costs (i.e. overhead) for implementing and maintaining such a monolithic structure should be factored in and their long-term sustainability seriously taken into consideration.

Table 19: Evaluation of a new legal entity definition

PROS	CONS
• Central, efficient management • Stricter implementation of exploitation strategies • Stability	• Bureaucracy overhead • High monetary initial investment needed • Resource-consuming to run • Not very flexible • May not be viable for some partners

[5] European IPR Helpdesk, Fact Sheet The Plan for the Exploitation and Dissemination of Results in Horizon 2020 - https://www.iprhelpdesk.eu/sites/default/files/newsdocuments/FS-Plan-for-the-exploitation-and-dissemination-of-results_1.pdf

4.4.2 Joint venture

Through a joint venture new business opportunity could be pursued by OPTIMAI partners who would also contribute with resources (financial, assets, skills, staff etc.) and share benefits and risks in the endeavour. In this case, a partnership would be created where shares could vary among partners. While a legal entity doesn't necessarily need to exist, a joint venture could use two partnership models:

a. A new organization possibly managed by one of the partners. Participants could contribute with infrastructure, staff and resources and get a stake of the revenues.
b. No organization would be created. This model would be like the current collaborative project model, where only staff efforts and resources are devoted to the endeavor. Very clear agreements on revenue sharing must be put forward in this case.

In both cases, a centralized joint venture agreement would be required to establish revenue, risks and liability sharing. This should make clear how decision making is carried out, setting up a board where the strategy and actions are decided. Venture partners should cover roles like those of a legal entity. The most complex part of setting up the joint venture is to agree for all partners on the costs and revenue sharing (who pays what and who cashes what). While more flexible than creating a legal entity, this model also poses the risk of being too constrained. For some partners, it could still be hard to formally engage (and commit) to providing (even non-monetary) resources to the venture and sign such type of agreement. Although lower compared to a legal entity, the costs for management (e.g. board meetings etc.) should be factored into this model.

Table 20: Evaluation of a joint venture definition

PROS	CONS
• Shared benefits and risks • Flexibility • Allows for both central and/or shared management • Allows to be widened to non-project entities	• Important changes need everyone's approval (slow) • May be harder to define profit sharing mechanisms • Lengthy process to set up the Venture and agree on revenue and cost models • Some partners (e.g. academia) may not be able to join due to legal constraints and bureaucracy

4.4.3 Multilateral collaboration agreements model

This model foresees flexible business agreements, with a series of partners collaborating in the delivery of products and services based on OPTIMAI, without a central structure or entity. Therefore, a global agreement is not strictly necessary: in fact, each partner becomes a 'link' in a supply chain and essentially establishes agreements with the other interested partners: clearly agreements between the involved parties are required but offer a high degree of flexibility. Typically, this partners' chain will be covered by all or most current OPTIMAI partners, who will

also be free to establish other business agreements with third parties. This type of governance will usually include at least the following actors/functions: sales, providers, and consultancies.

Adopting this flexible model will ensure that if certain roles cannot be covered by partners, third parties can be added. Partner responsibility will mostly be 'localised' in that partners will be responsible for delivery of their own product/service. Ownership and IPR are easily managed in this model, as each partner owns and manages its share and possible further agreements can be made on a case-by-case basis.

Table 21: Evaluation of a multilateral collaboration agreements model

PROS	CONS
• Little bureaucracy • Relatively easy to set-up • Maintains partners' flexibility • All kinds of partners can participate • Fits well with the Virtual Enterprise model • Well suited to exploit modular assets in diverse environments	• Risk of individual objectives clashing • Week global objectives • Might favour some partner over others • Changes in links might disrupt the chain

5 Standardization activities

There are two main aims on the standardization activities during OPTIMAI. It may help partners to develop and especially apply new technology faster due to normalized and well-tested methods or interfaces. On the other hand, the chance exists, that new technology, that has been developed during the project, may become part of existing standards or even may lead to new standards. OPTIMAI is a relatively large project with different stakeholders, so especially the interfaces will need to be uniformed.

While standardization will help to integrate existing parts more efficient, or may lead at least to a better compatibility, it may also be difficult to fully integrate a standard during research and prototyping period.

This section will outline the activities in task T8.3 Standardization activities, that is led by EVT.

Task 8.3 has started in M10. Since there, the main focus was on the two standards for Industrial Vision:

- OPC UA Vision Standard
- GeniCam/GigE Vision standard

EVT is a member of the GenICam standardization group of the European Machine Vision Association (EMVA). The regular meetings at the beginning 2021 were only virtual but with the end of 2021 also physical. The latest meeting especially for the GenICam was on the Vision show in Stuttgart in October where EVT was exhibiting and the intensive discussion during the show with many members was successful.

With focus on standardization activities during OPTIMAI, EVT also joined the OPC Machine Vision Companion working group, within the German Mechanical Engineering Industry Association (VDMA). As this working group still is relatively young, the OPC UA Vision Standard standard has a growing potential in the field, and it is demanded by the German automotive industry. EVT invests in the implementation on this standard to push it into the factory floor. Sequence diagrams, use case definitions and implementations during the OPTIMAI project aim to be compliant with the regularities from the OPC foundation, so that some of the work may contribute to the dissemination of the standard itself.

In October 2021 EVT used the world's leading trade fair for machine vision, "VISION 2021", as a dissemination event. EVT presented the OPTIMAI project to interested stakeholders from around the world. The event was held 5-7 October 2021 in Stuttgart, Germany. EVT had its own booth at the exhibition and took the opportunity to enhance its relationship with other members of the European Machine Vision Association (EMVA) and the German Mechanical Engineering Industry Association (VDMA). Fruitful conversations were had with working groups about the world of machine vision standards.

Further events within the standardization organizations are planned to begin in 2022.

In terms of communication EVT also plans to elaborate the needs of standardization of other protocols used in OPTIMAI, such as the REST API in the middleware or MQTT payload.

Consortium partners will also participate in several trade shows in 2022, such as Automate, Control and Boston Vision Show.

EVT is also planning to ask all project partners to contribute to standardization activities.

A survey is planned about existing standards, where all project partners can present and suggest standards for their specific fields. This survey will be held in M13, when most of the tasks have been started and the project partners will have already a vast experience on the topic. The survey will result in a preliminary list of standards that will be finally presented in D8.7(M18) and updated in D8.8 (M36).

As soon as specific OPTIMAI tasks end, EVT will ask the task leaders if there are working results, that may be unified throughout the project and that might be a base of a standard. The results will be shown in D8.8 (M36).

6 Conclusions and next steps

The current document presents the initial OPTIMAI plan for the exploitation of project outcomes during the first year of the project.

The current document presents the first version of the OPTIMAI Exploitation Plan which aims to lay the foundation to maximize the impact of the project during its duration and beyond its lifetime. This first version of the deliverable has been focused on the description of the OPTIMAI Framework, of the steps to reach the stated goals and it includes a preliminary description of the exploitable results. The document also includes the individual exploitation plan of each project partner and a first analysis of the joint exploitation strategies.

The next steps, in line with the project exploitation methodology explained in Section 3, will be – in the next months – to update (as a continuous process) the Key Exploitable Results with a focus on their market value and business potential and to consolidate the IPR Assessment.

In order to facilitate the process and ensure the vision is always shared and supported by all partners, as well as to keep the 'momentum' around exploitation high, a series of supporting activities will be carried out such as 'exploitation topic' focus groups, business-oriented sessions etc. and offline such as calls, interactions etc.

The result of this next period of activities will be reported in D8.7 OPTIMAI commercialization and exploitation strategy - 2nd version due at month 18 (June 2022).

Annex I Individual Exploitation Plan Template

Partner Profile

A description of the company/organization, reporting attitude to innovation, research activities, experience in big distributed projects, and specific role in the consortium.

Identification of opportunities

A description of the way OPTIMAI project results and outcomes are relevant to improve each partner business and activities, gaining a better positioning in the markets/areas of action or opening new possibilities in different ones.

Addressable Market

An overview of target audiences, for Instance for Scientific Partners are, i.e. research teams, students, general public, R&D industrial groups, etc, for industrial partners it can be internal (the own organization), external (potential customers) or a mixture of both. Where OPTIMAI can be applied and how, identifying what kind of needs customers have or what kind of expectations the solution needs to fulfil.

Value propositions

Details about the specific approach and actions to use the value of the results of the project in each area of business.