



iQonic

IQONIC

Innovative strategies, sensing and process chains for increased **Quality**, re-configurability, and recyclability of Manufacturing **Optoelectronics**

Deliverable

D2.1 User Requirements

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DISCLAIMER

The sole responsibility for the content of this publication lies with the iQonic project and in no way reflects the views of the European Union.



EXECUTIVE SUMMARY / ABSTRACT

The work within this task has focused on use cases and business objectives of ALPES, PRIMA, FILAR and BRIGHTERWAVE, following closely the needs of technical/research partners that have provided a detailed set of requirements and specifications both for end users and technical developers of iQonic project. The requirements are developed and configured following technical objectives, hardware and software needs of components within this project. End users and all technical partners of the iQonic consortium have consolidated their business, technical, non-technical requirements (i.e. wishes) and other type of requirements on how to build the iQonic system as a general solution to be applied within the optoelectronics industry in the future. The approach is based on the systems engineering and application and management of systems engineering process standard (ISO/IEC 26702) and will encompass the steps of stakeholders' identification, scenario definition, research needs and final requirements validation. Furthermore, scenarios will be defined addressing the use of iQonic components in the project pilots. During the proposal phase it was defined that iQonic will use an "Iterative Feedback approach with users in the LOOP" (IFLOOP), where the initial output of the task T2.1 will be used for the design of WP3-WP6 components. The user feedback and updated requirements will retrofit and improve s/w and process chain designs.

SCOPE

The iQonic supply chain and concept will be built with the utmost objective to provide new solutions addressing the needs for flexibility, efficiency and sustainability when manufacturing optoelectronics and photonics, bringing innovative and competitive products to the market, face future challenges regarding standards and legislation, and spread the knowledge to as many other sectors of the European manufacturing industry as possible. The scope of this work is to define and collect requirements and needs of iQonic consortium based on the defined methodology within this work as well as to solicit requirements at system-component and system-horizontal levels and make the final consolidation of the processed input. Furthermore, the final output will also identify KPIs to be monitored for the use case evaluation within the task T8.6 that will be reported in the confidential deliverable *D2.4 iQonic Use Cases*.

ABBREVIATIONS

Key Performance Factors	KPF
Technical Objective	TO
Key Performance Indicator	KPI
Electrostatic Discharge	ESD
Internet of Things	IoT
Cyber-Physical System	CPS
Reverse Supply Chain	RSC
Decision Support System	DSS
Manufacturing Execution Systems	MES
Maintenance Management System	MMS
Enterprise Resource Planning	ERP
Optoelectronics Research Centre	ORC
Laser Diode	LD
Light-Emitting Diode	LED
Augmented Reality	AR
Virtual Reality	VR
Requirement	RQ
Original Equipment Manufacturer	OEM
Human-Machine Interface	HMI



1 Objectives

Today, the demand for optoelectronic devices is rising and the advances in optoelectronics technologies is causing a revolution in consumer electronic goods, solar energy, communications, light-emitting diode (LED), industrial laser and other fields as well. However, the optoelectronics manufacturing is facing significant challenges in dealing with the evolution of the equipment, instrumentation and manufacturing processes they support. The optoelectronics and photonics industry is striving for higher customisation and individualisation since it is facing with the increment in complexity and variable volume of demand combined with the pressure to control production costs. Thus, the systems configurations need to change more frequently and dynamically including the automation and sustainability strategies as a most logical route to reduce production costs. Nowadays, the optoelectronics manufacturing should introduce new processes and technologies towards digital, virtual, flexible, zero-defect and resource-efficient factories in order to improve process efficiency, increase yield, reduce defect rates and the assembly costs.

In order to follow and accomplish the current market demands, the stakeholders' wishes and requirements as well as technical needs, specifications and possibilities, are to be defined, mapped and analysed. The scenario definition, analysis and final requirements validation will cover all these steps by following end users To-Be cases and Technical Objectives over the three iteration periods during the life time of this task, while implementing architecture and strategies of the iQonic vision.

1.1 Technical Objectives

During the proposal phase, the iQonic project has defined Technical Objectives (TO) as the main technological achievements to be followed, applied and updated (if necessary) after the revision of RQs in M20. The eleven TO will lead the project, allowing the optoelectronic industry to implement the eight zero-defect manufacturing strategies: DIAGNOSE, PREDICT, ADJUST, PREVENT, DETECT, MANAGE, SUSTAIN and REDESIGN in order to increase quality, re-configurability and recyclability. Identified use cases of consortium members ALPES, PRIMA, FILAR and BRIGHTERWAVE will be presented due M05 (*D2.4 iQonic Use Cases*), covering the pilot As-Is positions and iQonic To-Be scenarios, followed by the further elaboration due end of the WP2 (M20). The specific process chain architecture reported due M07 (*D2.3 iQonic system architecture process chain & Strategies*), TO as well as implementation of related strategies and their details, components and tools, will be monitored and reported together with revised TO (if necessary) within the deliverable *D2.5 Strategy implementation report* due M20 as a final output.

Technical Objective No.1 - Development of diagnostic system for adjustment of production processes.

The diagnostic system will be developed which goal is going to be to prepare the whole process chain for 20% faster reconfigurations, while maintain increased quality for higher yields (20%). This DIAGNOSE strategy will adjust the production processes for different factors of optical manufacturing such are:

- geometries (complex 3D shape),
- surfaces (contamination and scratch sensitive, coated),
- materials (fragile, brittle, soft) and
- weight and dimensions (small and medium sizes).

Furthermore, the process will be adapted respecting the three sensitivities of material, electrostatic discharge (ESD) and contamination, which will be reflected on the feeding, handling, alignment and bonding processes along the typical optoelectronics manufacturing process chain. The system will monitor and track the above key performance factors (KPFs) and the related sensitivity throughout the process chains and alter the production through the ADJUST strategy and ensure zero-defect from component to system level. iQonic will cover the overall process chains transferring the zero-defect requirement (RQ) from the component to the system level i.e., the opto-electrical system design for assembly and disassembly. Finally, the sensitivity will be taken care of as well, which will push iQonic on a major leap towards zero-defect production of optoelectronics components.

Technical Objective No. 2 - Development of continuous monitoring of the condition and performance.

This continuous monitoring of the multi-stage optoelectronics manufacturing systems will be developed on component and machine level that will enable sustainable and competitive manufacturing, i.e., data



management, sensors, processes design and setup as well as defect life-cycle management, disassembly and remanufacturing. Regarding the monitoring at machine level but also to collect and aggregate the data from existing and new sensors, the Internet of Things (IoT) i-Like Machine system of HOLONIX will be employed. Consequently, the online monitoring will be transformed from component to system characterisation during the assembly process chain. The processes itself, the handling-feeding tool, will take care of not only the contamination and defects (i.e., geometrical, semiconductor, layer defects), but also of the optical properties of the (partially) aligned system during assembly operating in real-time covering at least 90% of the production. iQonic will exploit the already installed actuators and sensors, along with the installation of the new sensing equipment provided during the projects life to acquire readings about the machine status, the in-process measurements (e.g. electronic nose, adaptive optics) and the optical sensors to evaluate the quality (high frequency laser).

Technical Objective No. 3 – employment of a highly flexible handling tool.

This handling and highly flexible tool will be able to provide a standardised interface allowing the handling both miniaturised and macroscopical parts – i.e. diverse designs (dimensions, geometry) – sensitivity, offering a new flexible process for material handling. The precise grasping hand of SHADOW will be able to establish electrical contact to active electro-optical components, either for grounding or for in-situ driving of the component. The grasping hand will receive input from the diagnostic and monitor (highly flexible) tool in order to reach the component accurately and safely during the alignment and bonding tasks. As a result, the handling tool will provide an interface for easy, precise and automated tool exchange technology by FICONTEC, that will take care of the specific sensitivity aspects through the monitoring of the component state from feeding to handling, to alignment and bonding. The data produced during these processes will be fed into the aggregated database ready to be processed by the event modelling and the artificial intelligence to PREDICT, DETECT, PREVENT, SUSTAIN and MANAGE any generated defect as well as to provide feedback allowing better designs and optimise the process chain for future iterations.

Technical Objective No. 4 - Employ a smart tag scanning process between the production stages.

The scanning process will be employed between the production stages in order to read the products specific requirements and automatically set-up the machine parameters, loading the actuators that configure the quality inspection solution. The barcode information provided from the higher levels (MES) and the production order itself will link all the data for each component not only to automate the loading process for programming the actuators but also to minimise the possibility of using the wrong set-up of process parameters for any given product. In addition, the metrology sensors will detect dimensional deviations and geometrical characteristics adding an extra layer of control to ensure zero-defects applications. This solution will be based on current “portable” metrology solutions developed by SENSAP and it will require both hardware and software integration with Online Data Management System of MANAGE Strategy. This involves advanced metrology, calibration and sensing, signal processing and model-based virtual sensing that will occur before each iteration in the workstations. Event pattern and anomaly detection, prognostics and positive/false alarm rates will be measured after a 6-month period of being employed.

Technical Objective No. 5 - Develop a reliable and precise non-destructive sensing system.

The sensing system will be developed for in-process evaluation of material and functional component properties. Its goal is to produce data about the material behaviour and its reactions to any given set of production parameters, allowing correlation of the various design and material characteristics with their behaviour during processing, and last with the outcome of the whole process through the quality inspection system. It will comprise the two innovative sensors:

- an adaptive optics laser and
- an odour sensing system.

The derived knowledge will allow optimal operations and strategies to minimise the generation of defects. The laser will receive in real-time an optical feedback about the features by the change the optical response adjusting the optics during the process to eliminate the generation of defects. The odour sensor will detect the organic compounds and will produce notifications to aware the operators. As the contamination sensitivity alters, the sensor will flag the production for deeper examination if there is a threat detected. The contamination scans, will be correlated with the quality and the ambient conditions during the processing.

***Technical Objective No. 6 - Develop a radical new design for sustainability process chain.***

The new design will be developed for a sustainability process chain for the assembly and disassembly in order to increase the pool of available components without affecting the quality. Disassembly as a very important matter for sustainability is very unusual in optics so far due to the fact that the properties of an optical component are typically irreversibly changed during assembly, in particular during bonding/fixation. iQonic via its intelligent engine and knowledge management, will provide feedback from the strong monitoring system to (re)design for sustainability benefitting the assembly chain. The dismantling and disassembly of optoelectronics components will be a subject of study in order to support decisions on their reuse (totally, partially), requalification and repair, as well as to develop a new process at their end-of-life. A cyber-physical system (CPS) will be used to evaluate both the functionality and integrity in order to proceed to downstream stages or upstream. The new Reverse Supply Chain (RSC) process will take action based on the components' design and material, so as the iQonic will either "consume" the products/material downstream, or "supply" them upstream to internal or external tiers. The holistic monitoring of iQonic will be active to the whole process chain, allowing more accurate decisions on their characterisation and testing approaches, to either move one stage forward, or stage(s) backward, or removed from production entirely. The new process of reverse supply chain and requalification of components at their end-of-life will aim for more than 20% introduction of recycled and recovered parts in the production to reduce the material costs by 12%.

Technical Objective No. 7 - Develop a machine learning system to predict quality.

This machine learning system for quality prediction will be developed according to each pre-selected setting having the overall performance indicator simulated to examine how they will affect the final cost. The retuning for optimal performance will reduce the costs by 20% and increase the yield by 22%. In order to increase the sustainability of optoelectronics components with different sensitivities and process requirements, iQonic will reduce the uncertainty around the process failures and delays, estimating the best planning, alternatives and adaptations. Such capabilities will be complemented by failure analyses methods to drill down at the root of a defect in order to allow 15% faster reconfiguration of the system against changing designs, process requirements, conditions, environments or system degradation. The learning controller will maintain a quality of 95% repeatability and 95% accuracy (inside the acceptable limits). The simulation system will perform an initial estimation of the future states, providing an expected outcome in availability, quality and performance. These will be updated based on historical and real time acquired data, taking into account the past, present, and future data to adjust. The system will be verified by checking if it preserves the desired quality in predefined pilot testing consistently, with controlled conditions, i.e. 1000 known samples, in controlled conditions.

Technical Objective No. 8 - Introduction of a self-adjusted inference engine.

By the introduction of the inference engine, detecting, measuring and monitoring the variables, events and situations will increase the performance by 20% and reliability of manufacturing systems from 0.85 to 0.9. iQonic will deploy an autonomous and self-adjusted early stage inference engine for real-time inspection, condition monitoring and control diagnosis at the shop-floor (i.e. process and artificial intelligence implementation). Data streams from multiple and disparate sources (e.g. sensors and actuators) will be collected, organised and consolidated through relevant models. The system will continuously mine these data streams and run the respective models to monitor operations and quality performance, to model designs (KPIs, sensitivity data), machines, processes and process chains. This will allow learning from experience in order to categorise products into classes on the basis of (nearly) real-time quality metrics, enabling not only detection of defects, but also prediction of their occurrence for each design. Overall, the proposed engine will perform monitoring, inspection and control at workstation, process and product level to issue warnings, alerts (e.g. about deviations from production and quality requirements), reports on (potential) defects or defect prone situations and pass related information to a higher level Decision Support System (DSS) for iQonic at manufacturing and enterprise level. A complementary goal relates to the reduction of false alarms based on lessons learnt, previous alarm activations, trends and by sharing information from one machine or process variant to another. To respond to changes in the production and product requirements (e.g. due to changing customer demand) the engine will allow algorithms to adapt to (frequent) changes/ reconfigurations of the production system. The generator will be able to adapt individual algorithms to the changes in the production



based on input received from existing information systems i.e. Manufacturing Execution Systems (MES), Maintenance Management System (MMS), Enterprise Resource Planning (ERP), etc., and instructions received directly from the higher level iQonic DSS.

Technical Objective No. 9 – Development of a higher-level Decision Support System.

The higher level DSS will be developed in order to assess the process chain's performance and accurately detect and predict defects deciding on actions to prevent their occurrence and provide recommendations about the strategies to activate at each time. The goal of this system is actually to increase both the flexibility and the quality by introducing self-adjustment mechanisms to maximise the performance, while synchronising material handling and feeding. In summary it will:

- deploy a new Internet of Things (IoT) middleware that is built on the existing solutions of integration and i-Like Machines to realise semantic interconnection of sensors and relative processes with the iQonic core elements and existing information infrastructure,
- develop multi-parametric models of production processes (at single stage) and investigate a sampling method and
- build an autonomous, self-adjusted intelligence engine for real-time inspection and control at the shop-floor and decision support towards measurable performance and process chain improvement, by triggering the strategies to DIAGNOSE, ADJUST, PREDICT, DETECT, PREVENT, MANAGE; SUSTAIN; and a complimentary REDESIGN strategy for increased sustainability in future operations.

Technical Objective No. 10 - Integrate different strategies for production monitoring and quality control.

The eight iQonic strategies will be developed to achieve the goal of sustainable manufacturing, based on modelling, simulating and forecasting the behaviour of production processes and resources. The strategies will DIAGNOSE the given designs, ADJUST the processes for production, assembly, and dismantling to handle complex shapes and versatile components, while PREDICT, DETECT, PREVENT, SUSTAIN and MANAGE defects during the production lifecycle phases. They will decide for non-repairable defect cases, calling for reuse and requalification actions and adjust the material handling, bonding, feeding, assembly and disassembly processes. Last, the lessons learnt will help to REDESIGN sustainable products. The outcome will be an integrated product-process-production system that will be embedded into their social, environmental and economical context of each opto-electrical factory.

Technical Objective No. 11 - Widespread adoption of IQONIC results.

While some of the largest activities concerning optoelectronics, manufacturing is concentrated in Germany, iQonic will spread its results to more areas to boost the innovation on photonics technologies. To this end the expertise of the Optoelectronics Research Centre (ORC) at the Tampere University of Technology (TUT), which is the strongest hub in Scandinavia concerning development of laser diode (LD) technology covering GaAs, InP-, and GaSb-based material systems, will be expanded to provide access for Nordic photonics companies to rapid prototyping of LD-based sub-systems. We should note that ORC has been extremely successful in spinning-out optoelectronics technology, with currently 12 start-ups including major players in medical laser instrumentation (Modulight) and fibre laser (Corelase). The fast development trends on photonics activities in Finland with at least 50 SMEs¹ will be the access point to advanced tools for optoelectronics assembly, which will be located at Tampere University of Technology is very timely. This role will be extended to Sweden via the strong interaction between the national photonics clusters (i.e. Photonics Finland and Photonics Sweden).

¹ <http://www.photonics.fi/members/>



2 Methodology

The work within this task T2.1 of iQonic project has been advanced considering the previous experience and know-how of the project consortium partners following and combining few methodologies for requirements definition. Following the research, end users and technical developers' needs, the requirements describe how the iQonic system behaves and it respectively consist of functional, non-functional requirements, presenting what and how the system should do and work and constrains that include application domain information. Below, few approaches have been reported and analysed where the methodology for encompassing this task has been defined as the combination of the reported approaches.

2.1 ISO/IEC 26702 Standard

The work within this task is based on ISO/IEC 26702:20072 standard or Systems Engineering - Application and Management of the Systems Engineering approach that defines the technical effort requirements of a business that are related to development of products, computers, software and processes that will sustain and evolve life cycle support for the products. The integrated technical approach of systems engineering process is periodically applied to develop or improve a product in order to satisfy market needs while providing related life cycle processes for product development, manufacturing, test, distribution, operation, support, training and disposal. This standard actually provides an approach for product development in a system context including the guidelines what organisational entities of a business must achieve to produce a quality, competitive product that will be marketable, will provide an acceptable return on investment to the enterprise, will achieve stakeholder satisfaction, and will meet public expectations. Also, its objective is to provide high-quality products and services, with the correct people and performance features at an affordable price and on time. This involves developing, producing, testing, and supporting an integrated set of products (e.g. hardware, software, data, etc.) and processes that is acceptable to stakeholders, satisfies enterprise and external constraints. This objective is achieved by simultaneous treatment of product and process content to focus project resources and design decisions for the establishment of an effective system design. This involves an integrated handling of all elements of a system, including those related to manufacturing, test, distribution, operations, support, training and disposal.

The extension of this approach, the ISO/IEC/IEEE 24748-4:20163 standard, identifies required processes for planning the Technical Management and execution of projects that implement considerable Systems Engineering efforts regarding the project's system products. The Technical Planning or Systems Engineering Planning should help to ensure that requirements related to the technical effort are elicited, documented, analysed, verified and managed.

2.2 Volere Approach

The Volere approach⁴ was one of the methodologies investigated as potentially suitable for this work. It is used as a basis on the requirements specifications providing the details of each of the requirements types appropriate to nowadays software systems. The idea is to provide help in requirements discovery and to be able to group the requirements that are relevant to a specific expert specialty. The Volere approach specifies few types of requirements that are considered in this work that may provide the solutions of the project.

- **Functional requirements:** fundamental or essential subject matter of the product, what the product has to do or what processing actions it must take.
- **Non-functional requirements:** the properties that the functions must have (e.g. performance and usability).
- **Project constraints:** restrictions on the product due to the budget or the time available to build the product whose design enforce limitations on how the product must be designed.

² ISO/IEC 26702:2007(E) IEEE Std 1220-2005 First edition 2007-07-15

³ ISO/IEC/IEEE 24748-4:2016 (E) First edition 2016-05-15

⁴ <http://www.volere.co.uk/>



- **Project drivers:** the business-related forces (e.g. the purpose of the project is a project driver, as are all of the stakeholders each for different reasons).
- **Project issues:** the conditions under which the project will be done. Basically, the reason for including this type is to present a coherent picture of all factors that contribute to the success or failure of the project and to illustrate how managers can use requirements as input when managing a project.

2.3 Alistair Cockburn Approach

Previously, Alistair Cockburn⁵ have reported on how to write (or review) functional requirements for object-oriented software systems as well as for embedded software and business process re-engineering work. His work provided guidelines and it contains some preliminary information on how the requirement looks like (e.g. primary actor, extensions, variations), where do they fit into the overall requirements gathering work, etc. This approach was considered and few ideas from this methodology were included in the iQonic requirements approach described within this work.

2.4 DoIT Approach

The Department of Information Technology (DoIT) of New Mexico have defined the Requirements Collection Template⁶ that was overviewed and considered in the purpose the iQonic requirement methodology definition within this work. They follow the business objectives as the starting point for the development of business requirements which are the basis of the project as well as further development of the product, that the project has been defined to develop. They also capture the requirements of what the project must do and the properties that the system(s) must have as:

- Business Requirements, the high-level needs of the project that are basically captured during the plan phase of the project, and
- User Requirements, the business users' needs in terms of functionality, usability, performance, security, legal compliance etc., that are captured during the definition phase of the project and will be used to develop the system requirements.

2.5 iQonic Requirement Approach Process

The previous sections provide an overview of various approaches and methodologies that have been taken into consideration for requirement definition and reporting. Combining these proposals, ATLANTIS prepared online workshop describing the iQonic approach to be followed during the consolidation of requirements for this task, providing the material, examples and template (Table 1-1). Encompassing use cases, eleven TO, business, research and technical needs as well as following the template, this task resulted in development and collection of business RQs of iQonic industrial partners and hardware/software RQs from all technical partners.

The work within the task is divided and respectively defined in three iteration periods.

- **Iteration I (M01-M04)** – requirement definition on the consortium needs according to their business and/or manufacturing processes, technical and non-technical needs, wishes and constrains. The requirement discovering will be led by the task leader and iQonic partners will provide their input.
- **Iteration II (M12-M14)** – revision and 1st quality check in order to establish the requirement priorities will be led by Technical Manager that will discuss with iQonic partners and decide on which requirements will be included in the system implementation.

⁵ Writing Effective Use Cases. Humans and Technology. Alistair Cockburn 1999.

⁶ http://www.doit.state.nm.us/project_templates.html



- **Iteration III (M18-M20)** – analysis and final validation by Technical Manager with help of iQonic partners. This final stage will involve various techniques (e.g. testing, prototyping, etc.) for the ultimate quality check.

This deliverable is the result of collecting RQs within the Iteration I period of the requirements system engineering process. The part of the information (*RQ ID, RQ Type, use case, Status, Parent Requirement, Summary, Rationale, Reporter and Date*) from the template (Table 1-1) is used as the starting point in this first iteration. Since this task is the periodical process and not a single stage process of the project, the possibility to outline and analyse all aspects of the iQonic system is provided during the end of the WP2. This document and (*full*) template will be applied collecting the rest of the information required further on throughout the two other respective Iterations (II and III) of the project that will encompass the process itself and complete this list of requirements in order to be deployed at the end of the project.

Table 1-1: The iQonic requirement template

RQ ID	< id, e.g. AL-XX, AT-T-XX, etc.>		RQ Type	<Business, Technical, Non-technical, Constrain>		Use Cases #	<end users, e.g. FILAR>	
Status	<i>New</i>	<x>	<i>Agreed-to</i>	<x>	<i>Baselined</i>	<x>	<i>Rejected</i>	<x>
Parent Requirement #	<Enter the unique id (s) for each requirement that this requirement supports. Note, this field will be empty (N/A) for high level requirements i.e., business requirements.>							
Title (Summary)	<Enter concise description of requirement.>							
Rationale (why, what, how)	<Provide a brief rationale, and or business value for the requirement.>							
Reporter	<Name of RQ. Provider, e.g. ATLANTIS>			Assignee		< WP Leader, Component owner, Technical Manager e.g. FRAUNHOFER >		
Priority	<i>Essential</i>	<x>	<i>Major</i>	<x>	<i>Medium</i>	<x>	<i>Optional</i>	<x>
Pre-conditions	<Describe known pre-conditions. Whenever possible, make sure they are measurable or verifiable.>							
Acceptance/Fit Criteria	<Provide a target that makes it possible to test if requirement was satisfied>							
Exceptions	<Specify possible exceptions that should be handled>							
Dependencies	<List another requirement, provide id(s) that this requirement is dependent on>							
Component/s	<Specify>							
Date (change history)	<List history of changes to this requirement>							



3 iQonic partnership and their intentions

The actors and stakeholders of iQonic project (Table 1-2) is a team made from industrial and academic associates that are experienced in cutting-edge technologies and active in the EU manufacturing research and innovation projects. These seventeen EU-based partners have gathered together following today's market needs and current technology approaches in order to cover all aspects of technical, industrial and business requirements and needs by providing a complete value chain through iQonic product and its services to the market.

Table 1-2: The iQonic project consortium

Short name	Name	Country
FRAUNHOFER*	<i>FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V.</i>	Germany
ATLANTIS	<i>ATLANTIS ENGINEERING AE</i>	Greece
BRUNEL	<i>BRUNEL UNIVERSITY LONDON</i>	United Kingdom
CORE	<i>CORE INNOVATION AND TECHNOLOGY OE</i>	Greece
POLIMI	<i>POLITECNICO DI MILANO</i>	Italy
SHADOW	<i>THE SHADOW ROBOT COMPANY LIMITED</i>	United Kingdom
HOLONIX	<i>HOLONIX SRL-SPIN OFF DEL POLITECNICO DI MILANO</i>	Italy
SENSAP	<i>SENSAP SWISS AG</i>	Switzerland
IP-ASCR	<i>FYZIKALNI USTAV AV CR V.V.I</i>	Czech Republic
PRIMA	<i>PRIMA ELECTRO SPA</i>	Italy
ALPES	<i>ALPES LASERS SA</i>	Switzerland
FORTH	<i>FOUNDATION FOR RESEARCH AND TECHNOLOGY HELLAS</i>	Greece
FILAR	<i>FILAR-OPTOMATERIALS SRL</i>	Italy
SACMI	<i>SACMI COOPERATIVA MECCANICI IMOLA SOCIETA COOPERATIVA</i>	Italy
FICONTEC	<i>FICONTEC SERVICE GMBH</i>	Germany
TUT	<i>TTY-SAATIO</i>	Finland
BRIGHTERWAVE	<i>BRIGHTERWAVE OY</i>	Finland

* Project Coordinator and Technical Manager within the iQonic project.

3.1 Industrial Partners

Industrial partners of iQonic project have provided their machines and services in several manufacturing sectors while proposing a novel approach for inspecting, handling and reusing opto-electrical parts. ALPES, PRIMA, FILAR and BRIGHTERWAVE and their main aims have been introduced respectively and briefly through the following sub-sections.

3.1.1 ALPES

ALPES is a very important fabless company in the fields of laser diodes and assembly, representing the huge sector of laser manufacturers. Their aims are to integrate the quality control of its outsourced processes, as well as its in-house processes, into a “single window platform”, which will allow them to have a better overview of the production process.



3.1.2 PRIMA

PRIMA Electro is a division of PRIMA INDUSTRIE Group that is a worldwide leader in the field of the laser machinery for the metal sheet cutting and welding applications in 2D and 3D. Through iQonic, PRIMA is planning to achieve optimised configurations of the diodes that will make it possible to overcome customisation limits, exploiting in an efficient way the laser process for different applications, according to the features of the beam.

3.1.3 FILAR

FILAR is a reliable supplier of photonic and optical materials manufacturing, representing big industrial sectors of supplying optical (synthetic) and laser crystals. By introducing the iQonic, FILAR expects to benefit by adding value to both on-line and off-line monitoring of the process chains by seeking more accurate feedback to deeper understanding and analysis.

3.1.4 BRIGHTERWAVE

BRIGHTERWAVE is a company developing miniaturised RGB lasers for Augmented Reality (AR) and Virtual Reality (VR) eyewear products to consumers and professionals. Their idea is to use iQonic and address the increased yield through the quality control of the produced lasers, and also speed-up the reconfiguration of the processes to host the high-volume production.

3.2 Technological providers partners

Beside the industry partners (iQonic end users) the consortium consists of:

- Research partners, that have a massive experience in research and development projects, especially in the Advanced Manufacturing and Photonics sector (FRAUNHOFER, BRUNEL, ATLANTIS, HOLONIX, CORE, TUT, POLIMI, FORTH, SHADOW, IP-ASCR) and
- Technology providing SMEs, that have successfully commercialised past EU project results and these results they are bringing on-board to improve and optimise addressing new challenges, i.e., HOLONIX (i-Like system), ATLANTIS (Decision Supply Chain - DSS, Reverse Supply Chain-RSC and Middleware), SENSAP (Metrology), SHADOW (Smart Grasping), FICONTEC (Flexible Reconfiguration), SACMI (Electronic Nose).



4 Industrial partners requirements

One of the steps of this work was to collect business requirements and high-level needs of our four pilots that are basically captured during the plan phase of the project but also elaborated during the task's life time. The idea is for these wishes, on how to build the iQonic system, to be followed that will provide guides how the general iQonic solution shall be applied within the optoelectronics industry in the future.

4.1 ALPES

RQ ID	AL-B-01	RQ Type	Business	Use Cases	ALPES			
Parent Requirement	FORTH technology sensitive to the problem.							
Title (Summary)	Defective hard-mask during front-end processing shall be detected prior to selective regrowth.							
Rationale (why, what, how)	Devices with defective hard-mask are un-usable. Detecting this problem early will allow either to repeat the deposition process or scrap the wafer in which case the problem is detected early and not only at the end of the front-end fabrication and thus saves resources. FORTH's technology might be sensitive to mask-adhesion problems.							
Reporter	ALPES		Assignee	FORTH				
Priority	<i>Essential</i>	No	<i>Major</i>	Yes	<i>Medium</i>	No	<i>Essential</i>	No
Date (change history)	07.01.2019							

RQ ID	AL-B-02	RQ Type	Business	Use Cases	ALPES			
Parent Requirement	N/A							
Title (Summary)	Local defects on wafers shall be detected at various front-end processing stages and reported to the DSS.							
Rationale (why, what, how)	Functional test is done after COS assembly. Defective devices that can be sorted-out prior to assembly and scrapped will not consume resources unnecessarily. Problem: Front-end processing is executed at remote FAB.							
Reporter	ALPES		Assignee	FORTH, ATLANTIS				
Priority	<i>Essential</i>	No	<i>Major</i>	Yes	<i>Medium</i>	No	<i>Essential</i>	No
Date (change history)	07.01.2019							



RQ ID	AL-B-03	RQ Type	Business	Use Cases	ALPES			
Parent Requirement	Defect aggregation performed in DSS; FICONTEC built machine can be used by ALPES.							
Title (Summary)	Aggregated mapping data shall be used to sort devices on wafer in different categories (scrap, client 1, product 1, ...)							
Rationale (why, what, how)	Using automated equipment to do the sorting helps the streamlining and speeds-up the process.							
Reporter	ALPES		Assignee	FICONTEC				
Priority	<i>Essential</i>	No	<i>Major</i>	No	<i>Medium</i>	No	<i>Essential</i>	No
Date (change history)	07.01.2019							

RQ ID	AL-B-04	RQ Type	Business	Use Cases	ALPES			
Parent Requirement	N/A							
Title (Summary)	Processed wafers with defects that reduce device lifetime shall be detected systematically and immediately after front-end processing.							
Rationale (why, what, how)	ALT testing performed systematically during incoming inspection on wafers arriving from front-end processing. Setup will be built by ALPES. Data can be interfaced with DSS etc.							
Reporter	ALPES		Assignee	ALPES, FRAUNHOFER				
Priority	<i>Essential</i>	No	<i>Major</i>	Yes	<i>Medium</i>	No	<i>Essential</i>	No
Date (change history)	07.01.2019							

RQ ID	AL-B-05	RQ Type	Business	Use Cases	ALPES			
Parent Requirement	FICONTEC machine accessible to ALPES							
Title (Summary)	COS assembly shall be performed by automated equipment.							
Rationale (why, what, how)	COS assembly has to be performed prior to functional test; automatizing this step will make ALPES' products and QCL-based solutions in general more competitive and interesting.							
Reporter	ALPES		Assignee	FICONTEC, FRAUNHOFER				
Priority	<i>Essential</i>	No	<i>Major</i>	Yes	<i>Medium</i>	No	<i>Essential</i>	No



Date (change history)	07.01.2019							
RQ ID	AL-B-06	RQ Type		Business	Use Cases		ALPES	
Parent Requirement	FICONTEC machine accessible to ALPES							
Title (Summary)	Device facet and top-contact inspection performed by automated equipment.							
Rationale (why, what, how)	Automatizing acquisition of front- and back-facet pictures with SoA inspection equipment will enhance efficiency of the process and yield precise information on waveguide geometry that can be fed-back to front-end fabrication and device analysis.							
Reporter	ALPES			Assignee		FICONTEC, FRAUNHOFER		
Priority	<i>Essential</i>	No	<i>Major</i>	Yes	<i>Medium</i>	No	<i>Essential</i>	No
Date (change history)	07.01.2019							

RQ ID	AL-B-07	RQ Type		Business	Use Cases		ALPES	
Parent Requirement	FICONTEC machine accessible to ALPES							
Title (Summary)	For high-volume product functional device test shall be performed on assembly machine for device pre-selection.							
Rationale (why, what, how)	QCL's for spectroscopic applications have stringent constraints on spectral purity; sorting-out multi-mode devices as early as possible will help save testing resources.							
Reporter	ALPES			Assignee		FICONTEC, FRAUNHOFER		
Priority	<i>Essential</i>	No	<i>Major</i>	No	<i>Medium</i>	No	<i>Essential</i>	No
Date (change history)	07.01.2019							

4.2 PRIMA

Within the 1st iteration period, PRIMA has defined three business requirements. Their details are presented below.

RQ ID	PR-B-01	RQ Type		Business	Use Cases		PRIMA	
Parent Requirement	N/A							



Title (Summary)	In-line Inspection: The product shall be inspected in a non-time-consuming way, avoiding the expensive stages performed only at the end of the packing process.							
Rationale (why, what, how)	PRIMA uses iQonic to model the diode packing using the robotic cell with high accuracy and automated self-reconfiguration. This will allow to obtain optimized and customized configurations based on the different requests to be satisfied. The online inspection process will immediately be able to detect faults and failures, giving the possibility to intervene where necessary and avoid damage. This will increase the flexibility of the process, the saving of materials and the production times.							
Reporter	PRIMA			Assignee			iQonic Consortium	
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	26.11.2018.							

RQ ID	PR-B-02	RQ Type	Business	Use Cases	PRIMA			
Parent Requirement	N/A							
Title (Summary)	Reconfiguration of the production line: Reduction of the Time-To-Market of new products							
Rationale (why, what, how)	Thanks to a reconfigurable production line in a short time thanks to CPS process control and data analysis. Through the data analysis it is possible to obtain lines of different types and consequently products with different characteristics (for example in our case diode with different power). This allows savings on the machinery to be used and therefore operating costs, savings on production times and the ability to more easily reach customers with different needs. Reduction of the Time-To-Market of new products, increasing the flexibility and modularity of the production process thanks to a new production line able to produce diodes with different power, wavelength and geometry, adapting the source for the specific application of the customer.							
Reporter	PRIMA			Assignee		iQonic Consortium		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	26.11.2018.							

RQ ID	PR-B-03	RQ Type	Business	Use Cases	PRIMA
Parent Requirement	N/A				
Title (Summary)	Process Monitoring: Disassembly, Remanufacturing & Reuse of the components, currently, these aspects are not managed due to the higher vertical production and the high operating costs.				



Rationale (why, what, how)	Through iQonic it will be possible to have an optimization of these three phases, thanks to real-time monitoring and better data management along the process steps. Monitoring is a strategic point for process management and complete traceability from the initial phase to the final phase of the diode production process. Monitor means collecting data for zero defect manufacturing. This will save on the waste of the raw material, also influencing the final cost of the components.							
Reporter	PRIMA			Assignee			iQonic Consortium	
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	26.11.2018.							

4.3 FILAR

Within the 1st iteration period, FILAR has defined two business requirements. Their details are presented below.

RQ ID	FI-B-01	RQ Type		Business		Use Cases	FILAR	
Parent Requirement	N/A							
Title (Summary)	Improvement of coated surfaces quality for laser applications.							
Rationale (why, what, how)	In the ICONIQ framework, FILAR intends to improve the quality control process. It is necessary to reinforce the existing methods and tools and introduce advanced solutions that are particularly important in understanding material structure composition. Other important factors to be considered are LDT (Laser Damage Threshold), luminescence and material performance and reliability in real laser systems and devices.							
Reporter	FILAR			Assignee			IQONIC Consortium	
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	16.01.2019							

RQ ID	FI-B-02	RQ Type		Business		Use Cases	FILAR	
Parent Requirement	N/A							
Title (Summary)	Boosting mechanical process for rods production.							



Rationale (why, what, how)	Through IQONIC we expect to refine both the extraction system and the various phases of mechanical process. By employing sensors and new microcontrollers, FILAR intends to increase its machine reliability, removing imperfections and reducing the running time.							
Reporter	FILAR			Assignee		IQONIC Consortium		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	16.01.2019							

BRIGHTERWAVE

Within the 1st iteration period, BRIGHTERWAVE has defined six business requirements. Their details are presented below.

RQ ID	BR-B-01	RQ Type	Business	Use Cases	BRIGHTERWAVE			
Parent Requirement	N/A							
Title (Summary)	The yield of assembly process for frequency-converted laser light sources shall be increased.							
Rationale (why, what, how)	BRIGHTERWAVE uses the iQonic to optimize the assembly process (alignment and bonding phases) of a frequency-converted laser module.							
Reporter	BRIGHTERWAVE			Assignee		iQonic Consortium		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	04.12.2018.							

RQ ID	BR-B-02	RQ Type	Business	Use Cases	BRIGHTERWAVE			
Parent Requirement	N/A							
Title (Summary)	The quality inspection for the components used in the assembly process of frequency-converted laser light sources shall be improved.							
Rationale (why, what, how)	BRIGHTERWAVE uses the iQonic to improve the yield of a frequency-converted laser module assembly by improving the incoming quality inspection of the optical components used in the module.							
Reporter	BRIGHTERWAVE			Assignee		iQonic Consortium		
Priority	<i>Essential</i>	No	<i>Major</i>	Yes	<i>Medium</i>	No	<i>Optional</i>	No



Date (change history)	04.12.2018.
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RQ ID	BR-B-03	RQ Type	Business	Use Cases	BRIGHTERWAVE			
Parent Requirement	N/A							
Title (Summary)	The yield of assembly process for ultra-compact laser projector shall be increased.							
Rationale (why, what, how)	BRIGHTERWAVE uses the iQonic to optimize the assembly process (alignment and bonding phases) of a laser projector module consisting of several optical components.							
Reporter	BRIGHTERWAVE		Assignee	iQonic Consortium				
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	04.12.2018.							

RQ ID	BR-B-04	RQ Type	Business	Use Cases	BRIGHTERWAVE			
Parent Requirement	N/A							
Title (Summary)	The quality inspection for the components used in the assembly process of laser projector modules shall be improved.							
Rationale (why, what, how)	BRIGHTERWAVE uses the iQonic to improve the yield of a laser projector assembly by improving the incoming quality inspection of the optical components used in the module.							
Reporter	BRIGHTERWAVE		Assignee	iQonic Consortium				
Priority	<i>Essential</i>	No	<i>Major</i>	Yes	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	04.12.2018.							

RQ ID	BR-B-05	RQ Type	Business	Use Cases	BRIGHTERWAVE
Parent Requirement	N/A				
Title (Summary)	The reuse-qualification of the components shall be improved.				
Rationale (why, what, how)	BRIGHTERWAVE uses the DSS to reuse/requalify components rejected in the incoming quality inspection of the assembly process (components could be used for modules intended for example at different wavelength/colour, lower output power or different operation temperature).				



Reporter	BRIGHTERWAVE			Assignee		iQonic Consortium		
Priority	<i>Essential</i>	No	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	Yes
Date (change history)	04.12.2018.							

RQ ID	BR-B-06	RQ Type	Business		Use Cases	BRIGHTERWAVE		
Parent Requirement	N/A							
Title (Summary)	The yield of manufacturing process for laser crystals used in laser modules shall be increased.							
Rationale (why, what, how)	BRIGHTERWAVE employs smart-tagging system to increase the yield of laser crystals (a key sub-component for laser modules).							
Reporter	BRIGHTERWAVE			Assignee		iQonic Consortium		
Priority	<i>Essential</i>	No	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	Yes
Date (change history)	04.12.2018.							



5 Technological providers requirements

The technical and research partners requirements of iQonic, are important for this task and essence for the development of the project in general. As technological providers, the needs (not the solution) have been provided following the iQonic requirements approach, based on hardware and software components of consortium partners. The idea is to start with the RQs that will be used for the design components within WP3-WP6, get the user feedback and updated requirements that will retrofit and improve s/w and process chain designs within iQonic solution. In details, during the first iteration period (M01-M04) the requirement collection on the consortium needs have been reported below, following manufacturing processes, technical and non-technical needs and wishes and constrains. The requirement discovering was led by the task leader and iQonic technological providing partners provided their input president in respective sub-sections below. It has to be noted that this task could be challenging since it is beginning of the project and some of the reported requirements within this first iteration period could have been described in a generic way. However, since there are other two iteration periods defined for quality check, reassessment and refinement of all reported requirements in this deliverable (and not only) they have been accepted for the current iteration.

5.1 HOLONIX

Within the 1st iteration period, HOLONIX has defined eight technical requirements. Their details are presented in respected sections.

5.1.1 KBS – Production process

RQ ID	HO-T-01	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	N/A							
Title (Summary)	The Knowledge Base System (KBS) shall store the whole information related to production processes, assets and products.							
Rationale (why, what, how)	KBS shall guarantee a coherent storage of the whole information in order to enable a correlation between the different pieces, e.g.: production stage – process parameters - defect generation. A triple store DB will be developed on this purpose.							
Reporter	HOLONIX			Assignee		FRAUNHOFER		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	20.12.2018.							

RQ ID	HO-T-02	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	HO-T-01							
Title (Summary)	The Knowledge Base System (KBS) shall store information according to a semantic model in order to be easily accessible by the users							
Rationale (why, what, how)	KBS shall make use of a semantic model to optimize the accessibility of information and the easiness of data retrieval by the users.							



Reporter	HOLONIX			Assignee		FRAUNHOFER		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	20.12.2018.							

RQ ID	HO-T-03	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	HO-T-01							
Title (Summary)	The Knowledge Base System (KBS) shall transform raw data from the shopfloor to be stored according to the iQonic semantic model							
Rationale (why, what, how)	KBS shall have a component (RDFizer) to transform raw data from sensors/machines and company's ERP/MES into triplets suitable to be stored in the ontological DB							
Reporter	HOLONIX			Assignee		FRAUNHOFER		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	20.12.2018.							

RQ ID	HO-T-04	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	HO-T-01							
Title (Summary)	The Knowledge Base System (KBS) shall make inference to make correlation between defects and process parameters							
Rationale (why, what, how)	KBS shall help users to reduce/eliminate defects through the development of a reasoner that will make correlation between products defects and process parameters							
Reporter	HOLONIX			Assignee		FRAUNHOFER		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	20.12.2018.							

5.1.2 KBS – Products reuse/requalification

RQ ID	HO-T-05	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
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Parent RQ	N/A							
Title (Summary)	The Knowledge Base System (KBS) shall store the whole information related to product defects and technologies and tools for products reuse and requalification.							
Rationale (why, what, how)	KBS shall guarantee a coherent storage of the whole information in order to enable a correlation between the different pieces, e.g.: defective product – technology to be applied – assets and tools. Data will be stored according to a semantic structure.							
Reporter	HOLONIX			Assignee		POLIMI		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	20.12.2018.							

RQ ID	HO-T-06	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	HO-T-05							
Title (Summary)	The Knowledge Base System (KBS) shall store information according to a semantic model in order to be easily accessible by the users							
Rationale (why, what, how)	KBS shall make use of a semantic model to optimize the accessibility of information and the easiness of data retrieval by the users.							
Reporter	HOLONIX			Assignee		POLIMI		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	20.12.2018.							

RQ ID	HO-T-07	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	HO-T-05							
Title (Summary)	The Knowledge Base System (KBS) shall transform raw data from the shopfloor to be stored according to the iQonic semantic model							
Rationale (why, what, how)	KBS shall have a component (RDFizer) to transform raw data from sensors used for quality control and information related to reuse and requalification technologies into triplets suitable to be stored in the ontological DB							
Reporter	HOLONIX			Assignee		POLIMI		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	20.12.2018.							



RQ ID	HO-T-08	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	HO-T-05							
Title (Summary)	The Knowledge Base System (KBS) shall make inference to make correlation between defective products and reuse/requalification technologies							
Rationale (why, what, how)	KBS shall help users to reduce/eliminate scraps through the development of a reasoner that will make correlation between defective products, technology to be applied to reuse/requalify them and tool/assets required.							
Reporter	HOLONIX			Assignee		POLIMI		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	20.12.2018.							

5.2 ATLANTIS

Within the 1st iteration period, ATLANTIS has defined twelve technical requirements and three non-technical requirements. Their details are presented in respected sections.

5.2.1 Decision Support System

RQ ID	AT-T-01	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	N/A							
Title (Summary)	The higher-level Decision Support System (DSS) shall respond to the defects and their severity in an optimum way.							
Rationale (why, what, how)	The higher-level Decision Support System (DSS) shall enable optimum response to other suggestions in order to minimize defects and their severity.							
Reporter	ATLANTIS			Assignee		FRAUNHOFER, ATLANTIS		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	30.11.2018.							

RQ ID	AT-T-02	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	AT-T-01							
Title (Summary)	The DSS shall analyse the defect types from all use cases.							



Rationale (why, what, how)	The clarification and analysis of common causes of defects are to be produced by DSS in terms of defect severity, occurrence and impact on involved process chain and production.							
Reporter	ATLANTIS			Assignee		FRAUNHOFER, ATLANTIS		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	30.11.2018.							

RQ ID	AT-T-03	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	AT-T-01							
Title (Summary)	DSS shall support risk assessment (IEC3110:2009) as well as to adopt risk-based thinking (in line with ISO 9001:2015).							
Rationale (why, what, how)	DSS shall adopt risk-based thinking and support faster and better decision making at end users' shop-floor.							
Reporter	ATLANTIS			Assignee		FRAUNHOFER, ATLANTIS		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	30.11.2018.							

RQ ID	AT-T-04	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	AT-T-01							
Title (Summary)	DSS shall incorporate autonomous and hierarchical decision support for optimum response to defects.							
Rationale (why, what, how)	The DSS is to provide recommendations for optimum response to defects.							
Reporter	ATLANTIS			Assignee		FRAUNHOFER, ATLANTIS		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	30.11.2018.							

RQ ID	AT-T-05	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
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Parent RQ	AT-T-01							
Title (Summary)	DSS shall define rules and conditions to be met for each use case.							
Rationale (why, what, how)	DSS shall define rules and conditions to be met for each use case based on the semantic along with conditions for the activation of each one of the iQonic Strategies.							
Reporter	ATLANTIS			Assignee		FRAUNHOFER, ATLANTIS		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	30.11.2018.							

RQ ID	AT-T-06	RQ Type		Technical	Use Cases		ALPES, FILAR, PRIMA, BRIGHTERWAVE	
Parent RQ	AT-T-01							
Title (Summary)	The DSS shall improve the efficiency of future recommendations, both for process-chain optimization and for iQonic Strategies activation.							
Rationale (why, what, how)	DSS shall store and analyse the effects and impacts from iQonic Strategies activation through its machine-learning element and provide improved future recommendations to the end user.							
Reporter	ATLANTIS			Assignee		FRAUNHOFER, ATLANTIS		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	30.11.2018.							

5.2.2 Reverse Supply Chain

RQ ID	AT-T-07	RQ Type		Technical	Use Cases		ALPES, FILAR, PRIMA, BRIGHTERWAVE	
Parent RQ	N/A							
Title (Summary)	Reverse Supply Chain (RSC) of iQonic shall understand when the defected parts/products are detected in downstream stages and shall decide the possible redirection.							
Rationale (why, what, how)	The RSC process of iQonic will be realized when the defected products/parts are detected in downstream stages, in order to decide their possible redirection, either to upstream stages for remanufacturing or to other supply-chain tiers for possible disassembly, recycling or disposal.							
Reporter	ATLANTIS			Assignee		FRAUNHOFER, ATLANTIS		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No



Date (history)	30.11.2018.							
RQ ID	AT-T-08	RQ Type		Technical	Use Cases		ALPES, FILAR, PRIMA, BRIGHTERWAVE	
Parent RQ	AT-T-07							
Title (Summary)	The RSC shall use a rule-based engine with rules defining the conditions to be met (e.g. defect severity and type, recoverable, value to recover, repairable, defect origin, stage, internal/external supply tier, etc.).							
Rationale (why, what, how)	The RSC shall use a rule-based engine with rules defining the conditions to be met considering the involved stages, tiers and conditions for product/part reuse and requalification. Semantic rules should be defined for the reverse process based on use-case input analysis.							
Reporter	ATLANTIS			Assignee		FRAUNHOFER, ATLANTIS		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	30.11.2018.							

5.2.3 Middleware

RQ ID	AT-T-09	RQ Type		Technical	Use Cases		ALPES, FILAR, PRIMA, BRIGHTERWAVE	
Parent RQ	N/A							
Title (Summary)	Manufacturing execution systems (MES) and other higher-level management systems shall exchange data, alarms about predicted/detected defects, recommendations, production and product requirements.							
Rationale (why, what, how)	Manufacturing execution systems (MES) and other higher-level management systems shall communicate through middleware application that will be designed according to the standardized protocols and communication means (OPC, OPC-UA, UMCM), based on industrial standards (e.g. IEC 62714, IEC 62264, OPC UA).							
Reporter	ATLANTIS			Assignee		FRAUNHOFER, ATLANTIS		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	30.11.2018.							

RQ ID	AT-T-10	RQ Type		Technical	Use Cases		ALPES, FILAR, PRIMA, BRIGHTERWAVE	
Parent RQ	AT-T-09							



Title (Summary)	The middleware shall perform the semantic modelling of the data to be exchanged with MES and other higher-level management systems.							
Rationale (why, what, how)	Perform the semantic modelling of the data to be exchanged for interfacing middleware with MES and other higher-level management systems. This calls for use of appropriate ontology elements and semantic annotation of all exchanged data.							
Reporter	ATLANTIS			Assignee		FRAUNHOFER, ATLANTIS		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	30.11.2018.							

5.2.4 General

RQ ID	AT-T-11	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	N/A							
Title (Summary)	Data shall be collected and analyzed for monitoring of iQonic strategies implementation.							
Rationale (why, what, how)	Both iQonic component level development (vertical) and process chains implementation level (horizontal) will be implemented at each pilot use case scenario and system operational environment. Furthermore, process chain status measurement analysis will be adapted to provide the means for process validation.							
Reporter	ATLANTIS			Assignee		FRAUNHOFER, ATLANTIS		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	30.11.2018.							

RQ ID	AT-T-12	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	AT-NT-13							
Title (Summary)	The collected data shall be analyzed in order to evaluate the effectiveness, reliability, impact and acceptance of ICONIC system.							
Rationale (why, what, how)	The analysis of the collected data will allow to extrapolate trends and assess the effective performance of iQonic, and to draw conclusions on the fulfillment of expected impact and stakeholder's expectations, both in terms of effectiveness / efficiency / reliability / objectives / expectations fulfilment analysis, as well as social and economic impact on the manufacturing environment.							
Reporter	ATLANTIS			Assignee		FRAUNHOFER, ATLANTIS		



Priority	<i>Essential</i>	No	<i>Major</i>	Yes	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	30.11.2018.							

RQ ID	AT-NT-13	RQ Type	Non-Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	Data shall be collected and organized from pilot demonstrations.							
Rationale (why, what, how)	The data for technical, user acceptance and factory impact indicators shall be gathered in different formats (rtf documents for user acceptance, questionnaires / online instruments, spreadsheets with data for technical KPIs, data of ERP-MES-SCADA repositories, data from impact checklists), organized from pilot demonstrations.							
Reporter	ATLANTIS			Assignee	FRAUNHOFER, ATLANTIS			
Priority	<i>Essential</i>	No	<i>Major</i>	Yes	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	30.11.2018.							

RQ ID	AT-NT-14	RQ Type	Non-Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	A Knowledge Management document shall be created incorporating the technical and business logic created during the project.							
Rationale (why, what, how)	A Knowledge Management document shall be created, based on Data Management Planning, incorporating in a structured way the technical and business logic created during the project, describing how the acquired data and knowledge will be shared and/or made open, and how it will be maintained and preserved. Identifiable project data will be provided in a manner to define relevant knowledge, increase partner's awareness, validate the result and time frame of actions.							
Reporter	ATLANTIS			Assignee	FRAUNHOFER, CORE, ATLANTIS			
Priority	<i>Essential</i>	No	<i>Major</i>	Yes	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	30.11.2018.							

RQ ID	AT-NT-15	RQ Type	Non-Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
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Parent RQ	AT-NT-14							
Title (Summary)	The project results obtained during the project life time shall be protected.							
Rationale (why, what, how)	The project results obtained during the project life time shall follow the IPR activities (e.g. patent searches, filling or patent or other IPR applications, develop protection licenses, etc.) in order to be protected.							
Reporter	ATLANTIS			Assignee		FRAUNHOFER, CORE ATLANTIS		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	30.11.2018.							

5.3 SENSAP

Within the 1st iteration period, SENSAP has defined fifteen technical requirements and five non-technical requirements. Their details are presented in respected sections.

5.3.1 Inspection & metrology infrastructure to monitor the KPIs

RQ ID	SE-T-01	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	Visual Quality Inspection							
Rationale (why, what, how)	iQonic should define in all the use cases the requirements (e.g. resolution, accuracy, performance, classification of error types) and the potential positions in the production chain where the visual quality inspections will take place							
Reporter	Sensap Swiss			Assignee		FRAUNHOFER		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	11/01/2019							

RQ ID	SE-T-02	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	SE-T-01							
Title (Summary)	Visual Quality Inspection Methodologies and Techniques							
Rationale (why, what, how)	iQonic should investigate, update and develop the visual inspection system depicted from the user case requirements for the analysis of the quality of the final product or the semi-ready product throughout the production chain in order for a decision, based on the product quality, being made by the upper level systems of the iQonic platform.							
Reporter	Sensap Swiss			Assignee		FRAUNHOFER		



Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	11/01/2019							

RQ ID	SE-T-03	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	SE-T-01							
Title (Summary)	In-Line metrology							
Rationale (why, what, how)	iQonic visual inspection system should be directly integrated into the production process. The product under inspection is measured without detours, ejections or separate test stations.							
Reporter	Sensap Swiss			Assignee	FRAUNHOFER			
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	11/01/2019							

5.3.2 Smart tagging for automatic setting-up the process chain parameters

RQ ID	SE-T-04	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	Smart Product							
Rationale (why, what, how)	A product should identify itself to the modules, providing all information required to accomplish its process on module. RFIDs/2D-Barcode are attached to the product following encoding standards (e.g. GS1-128), so that product-related information can be accessed							
Reporter	Sensap Swiss			Assignee	FRAUNHOFER			
Priority	<i>Essential</i>	No	<i>Major</i>	Yes	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	09/01/2019							

RQ ID	SE-T-05	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	SE-T-04							
Title (Summary)	Smart Tag Scanning							



Rationale (why, what, how)	A smart tagging scheme should be employed in order to linking all the data for each component to not only automate the loading process for programming the actuators, but also to minimize the possibility of using the wrong set-up of process parameters for any given product							
Reporter	Sensap Swiss			Assignee		FRAUNHOFER		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	09/01/2019							

5.3.3 Multisensorial data acquisition network for manufacturing opto-electrical parts

RQ ID	SE-T-06	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	N/A							
Title (Summary)	iQonic should be able to exchange data with existing infrastructure/assets (legacy systems) at the shop-floor							
Rationale (why, what, how)	A layer that facilitate the data exchange, flow and sharing between software components/services, based on industrial standards (e.g. OPC UA) should be designed and developed.							
Reporter	Sensap Swiss			Assignee		FRAUNHOFER		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	02/01/2019							

RQ ID	SE-T-07	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	SE-T-06							
Title (Summary)	A common semantic data modelling.							
Rationale (why, what, how)	Modelling of the data to be exchanged by the acquisition module to the upper level sub-systems of the iQonic should be designed and agreed between involved partners.							
Reporter	Sensap Swiss			Assignee		SENSAP, HOLONIX, ATLANTIS, FRAUNHOFER		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	02/01/2019							

RQ ID	SE-T-08	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
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Parent RQ	N/A							
Title (Summary)	Access to physical data using sensors							
Rationale (why, what, how)	The iQonic will provide the necessary mechanisms for sensing (i.e. to extract information from heterogenous data sources both physical and software assets)							
Reporter	Sensap Swiss			Assignee		FRAUNHOFER		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	02/01/2019							

RQ ID	SE-T-09	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	The traceability of data collected, and machine/industrial assets observations should be guaranteed.							
Rationale (why, what, how)	All the data collected and extracted from machines/industrial assets must be related to a standard reference system to enable the connection, mapping and tracking of the extracted data and observations to machines/industrial assets, data analytics services, etc.							
Reporter	Sensap Swiss			Assignee		FRAUNHOFER,		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	02/01/2019							

5.3.4 Integration of software – hardware platforms and tools

RQ ID	SE-T-10	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	iQonic needs to operate in a network based environment							
Rationale (why, what, how)	To use web-based technologies to allow all the components and layers within the system to connect with other part of the system itself that is available in the same network							
Reporter	Sensap Swiss			Assignee		FRAUNHOFER		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	02/01/2019							

RQ ID	SE-T-11	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA,			
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						BRIGHTERWAVE		
Parent RQ	N/A							
Title (Summary)	The system should leverage standard as much as possible							
Rationale (why, what, how)	To design and develop a layer that deeply relies on standards to support and facilitate the integration of legacy and heterogeneous machines/industrial assets							
Reporter	Sensap Swiss			Assignee			FRAUNHOFER	
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	02/01/2019							

RQ ID	SE-T-12	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	To design, develop and install a "non" intrusive system							
Rationale (why, what, how)	The system should not use communication technologies that interfere with existing communication infrastructure							
Reporter	Sensap Swiss			Assignee			FRAUNHOFER	
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	02/01/2019							

RQ ID	SE-T-13	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	iQonic platform and communications should be secure							
Rationale (why, what, how)	Several data sources generate data that needs to be collected and sent over public and/or private networks to a possibly remote infrastructure in order to be analyzed. In the same way, data generated on a remote location received back to the iQonic module in order to integrate the received information into the process							
Reporter	Sensap Swiss			Assignee			FRAUNHOFER	
Priority	<i>Essential</i>	No	<i>Major</i>	Yes	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	02/01/2019							

RQ ID	SE-T-14	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
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Parent RQ	N/A							
Title (Summary)	iQonic system should employ modularity principle.							
Rationale (why, what, how)	System components should be loosely coupled and reconfigurable on a plug and play principle so as the system be able to respond to changing customer requirements and overcome internal system failures.							
Reporter	Sensap Swiss			Assignee			FRAUNHOFER	
Priority	<i>Essential</i>	No	<i>Major</i>	No	<i>Medium</i>	Priority	<i>Essential</i>	No
Date (change history)	09/01/2019							

RQ ID	SE-NT-15	RQ Type	Non-technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	iQonic platform architecture shall support cloud infrastructure							
Rationale (why, what, how)	A cloud infrastructure should be supported so as the iQonic could aligned with Industry 4.0 specification and benefit from it (secure, scalability, etc)							
Reporter	Sensap Swiss			Assignee			FRAUNHOFER	
Priority	<i>Essential</i>	No	<i>Major</i>	Yes	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	02/01/2019							

RQ ID	SE-NT-16	RQ Type	Non-technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	iQonic platform							
Rationale (why, what, how)	The iQonic platform shall provide technical support, business support services to platform users.							
Reporter	Sensap Swiss			Assignee			FRAUNHOFER	
Priority	<i>Essential</i>	No	<i>Major</i>	No	<i>Medium</i>	Yes	<i>Optional</i>	No
Date (change history)	11/01/2019							

RQ ID	SE-NT-17	RQ Type	Non-technical	Use Cases	ALPES, FILAR, PRIMA,			
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						BRIGHTERWAVE		
Parent RQ	N/A							
Title (Summary)	iQonic platform							
Rationale (why, what, how)	Architecture shall comply with the emerging standards (RAMI 4.0 and the Industrial Internet Consortium)							
Reporter	Sensap Swiss			Assignee		FRAUNHOFER		
Priority	<i>Essential</i>	No	<i>Major</i>	Yes	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	11/01/2019							

RQ ID	SE-NT-18	RQ Type	Non-technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	iQonic Data modelling							
Rationale (why, what, how)	The semantics of modelling in iQonic must be based on standardized meta-models and ontologies and should support the production and be extensible.							
Reporter	Sensap Swiss			Assignee		FRAUNHOFER		
Priority	<i>Essential</i>	No	<i>Major</i>	Yes	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	11/01/2019							

RQ ID	SE-NT-19	RQ Type	Non-technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	iQonic Security							
Rationale (why, what, how)	The security framework shall ensure confidentiality of data and prevent unauthorized access to the platform.							
Reporter	Sensap Swiss			Assignee		FRAUNHOFER		
Priority	<i>Essential</i>	No	<i>Major</i>	Yes	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	11/01/2019							



RQ ID	SE-T-20	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	Provide a set of Human Machine Interfaces (HMI) to allow humans to interact with it							
Rationale (why, what, how)	iQonic should provide graphical interfaces for data visualization The data visualization will ensure the visualization of the KPI over the time, the possibility to define new KPIs and the necessary mechanisms to support the human in the decision making process.							
Reporter	Sensap Swiss		Assignee	FRAUNHOFER				
Priority	<i>Essential</i>	No	<i>Major</i>	Yes	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	02/01/2019							

5.4 ficonTEC

Within the 1st iteration period, ficonTEC has defined ten technical requirements. Their details are presented below.

5.4.1 Hardware for automated assembly

RQ ID	FIC-T-01	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	Assembly process chain							
Rationale (why, what, how)	The assembly process chains used at the end users should be documented to allow FICONTEC to make a conceptual study about possible assembly machine layout for the project.							
Reporter	FICONTEC		Assignee	ALPES, FILAR, PRIMA, BRIGHTERWAVE				
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	16.01.2019							

RQ ID	FIC-T-02	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE
Parent RQ	FIC-T-01				
Title (Summary)	Component size and quantity				



Rationale (why, what, how)	The size of the photonic components to be handled and assemble should be documented to choose a proper handling mechanism.							
Reporter	FICONTEC			Assignee		ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	16.01.2019							

RQ ID	FIC-T-03	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	FIC-T-01							
Title (Summary)	Alignment processes							
Rationale (why, what, how)	The concepts used for the alignment of optical components needs to be documented. This could be either passive (vision based) or active (device under operation) processes. The alignment tolerances should be reported to decide for a proper machine layout.							
Reporter	FICONTEC			Assignee		ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	16.01.2019							

RQ ID	FIC-T-04	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	FIC-T-01							
Title (Summary)	Fixation processes							
Rationale (why, what, how)	The way how the optical components are fixed after alignment needs to be documented to allow for a proper machine layout. This includes the used material for fixation for bonding or epoxy based processes.							
Reporter	FICONTEC			Assignee		ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	16.01.2019							

RQ ID	FIC-T-05	RQ Type	Technical		Use Cases	FORTH		
Parent RQ	N/A							



Title (Summary)	Inspection system							
Rationale (why, what, how)	The characteristics of the digital adaptive optics system need to be known for implementation into the machine.							
Reporter	FICONTEC			Assignee		FORTH		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	16.01.2019							

RQ ID	FIC-T-06	RQ Type	Technical	Use Cases	FORTH			
Parent RQ	FIC-T-05							
Title (Summary)	Hardware of inspection system							
Rationale (why, what, how)	The dimensions and weight as well as typical hardware interface like electrical and mechanical connections of the digital adaptive optics system needs to be known for implementation into the machine.							
Reporter	FICONTEC			Assignee		FORTH		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	16.01.2019							

RQ ID	FIC-T-07	RQ Type	Technical	Use Cases	FORTH			
Parent RQ	FIC-T-05							
Title (Summary)	Software interface of inspection system							
Rationale (why, what, how)	The software interface of the digital adaptive optics system needs to be known for implementation into the machine.							
Reporter	FICONTEC			Assignee		FORTH		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	16.01.2019							

RQ ID	FIC-T-08	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	Sensor data							



Rationale (why, what, how)	The amount of required sensor data and the format in which the data needs to be saved needs to be known to allow for use of evaluation of this data for artificial intelligence algorithms.							
Reporter	FICONTEC			Assignee		BRUNEL		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	16.01.2019							

RQ ID	FIC-T-09	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	N/A							
Title (Summary)	Electronic nose							
Rationale (why, what, how)	The interface to the electronic nose needs to be known for proper implementation into the assembly machine.							
Reporter	FICONTEC			Assignee		Sacmi		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	16.01.2019							

RQ ID	FIC-T-10	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	N/A							
Title (Summary)	Electronic nose							
Rationale (why, what, how)	The chemicals which can be detected by the electronic noise should be known to plan for a proper use in the assembly machine							
Reporter	FICONTEC			Assignee		Sacmi		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	16.01.2019							

5.5 SACMI

In the first iteration SACMI has defined seven technical requirements and two constraints. Their details are presented in respected sections.

5.5.1 Interfacing of SACMI instrument to the data acquisition system



RQ ID	SA-T-01	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	Input/output between system controller (DSS) and electronic nose shall be involved within the sub-system and components.							
Rationale (why, what, how)	Input from system controller (DSS) shall be involved within the sub-system and components by the usage of HMI, RS-232 or remote control (via GSM) that will provide direct control over the electronic nose. It is also necessary to define which outputs the system controller (DSS) requires.							
Reporter	SACMI			Assignee	BRIGHTERWAVE, FICONTEC, FRAUNHOFER, BRUNEL, ATLANTIS, HOLONIX, TUT, POLIMI, FORTH, SENSAP, SHADOW, IP-ASCR (HiLASE)			
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	10.12.2018.							

5.5.2 Environmental operational condition

RQ ID	SA-T-02	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	Environment experimental condition (temperature and humidity) shall be examined within the sampling chamber.							
Rationale (why, what, how)	(what): The sampling chamber and the sample itself shall be involved within the sub-system and components. and it shall be checked that the range of temperature and humidity within the chamber are, respectively, between 0° and 60 °C, and between 0% and 60 %. The scope is to inform the operators of the assignee on the procedure to follow and the parameters to respect in order to avoid mistakes leading to the malfunction of the electronic nose.							
Reporter	SACMI			Assignee	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Priority	<i>Essential</i>	No	<i>Major</i>	Yes	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	10.12.2018.							



RQ ID	SA-T-03	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	Environmental operational condition shall be examined within the room where the electronic nose is placed.							
Rationale (why, what, how)	(what): The room where the electronic nose is placed shall be part of the involved sub-system and components and shall respect some conditions, i.e. it has a temperature range from 15 to 30 °C, relative humidity range from 0 to 50 %, in absence of dust in the air. The scope is to inform the assignee's operators on the environment characteristics and parameters to be respected since he is not informed on the parameters and procedures to respect.							
Reporter	SACMI		Assignee	FRAUNHOFER, ALPES, FILAR, PRIMA, BRIGHTERWAVE				
Priority	<i>Essential</i>	No	<i>Major</i>	Yes	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	10.12.2018.							
RQ ID	SA-T-04	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			

RQ ID	SA-T-04	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	SA-T-02							
Title (Summary)	Ambient air shall be used as gas carrier within the chamber							
Rationale (why, what, how)	The scope of this requirement is to ensure that the samples are not maintained in vacuum or in inert atmosphere during the measurement phase, since the electronic nose is calibrated to work in ambient air. Inside the sampling chamber, the air composition and pressure to be maintained for the proper function of the nose shall be as close as possible to ambient air conditions, meaning that no significant excess of Oxygen, Carbon dioxide, Nitrogen or Argon (inert atmosphere) should be present.							
Reporter	SACMI		Assignee	FRAUNHOFER, ALPES, FILAR, PRIMA, BRIGHTERWAVE				
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No



Date (change history)	10.12.2018.
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5.5.3 Sensor array

RQ ID	SA-C-05	RQ Type	Constraint	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	The operator or control system shall wait for stationary signal from the electronic nose.							
Rationale (why, what, how)	The scope of this constraint is to inform the users on timing for the sampling, If the sampling time is not long enough to achieve a stationary signal, the output could not be representative of the sample. Approximately 5-10 minutes are required before starting sampling since the gas sample is presented to the electronic nose, or a change in measurement conditions occurs. As a consequence, the sampling rate of the device is not higher than one sample (or one batch of samples) every 5 minutes. Incorrect measurements can be generated if the operator does not wait the requested time because he/she is not informed, or the process of the user does not allow to wait 5 to 10 minutes.							
Reporter	SACMI			Assignee	FRAUNHOFER, ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	10.12.2018.							

RQ ID	SA-C-06	RQ Type	Constraint	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	SA-C-05							
Title (Summary)	Maximum number of different sensing signals to be recognized by the sensor array chosen to measure the concentration of particles in the air							
Rationale (why, what, how)	The scope of this requirement is to inform the assignee of this constraint that the classification algorithm is less efficient when the instrument is trained to detect more than 4 similar odors. If the instrument is trained to recognize a high number of odors with similar chemical composition, the probability of having wrong classifications increases.							
Reporter	SACMI			Assignee	ALL			
Priority	<i>Essential</i>	No	<i>Major</i>	No	<i>Medium</i>	Yes	<i>Optional</i>	No



Date (change history)	10.12.2018.
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5.5.4 Electronic nose

RQ ID	SC-T-07	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	Optimal and maximum tube length for connecting the electronic nose to the sampling chamber.							
Rationale (why, what, how)	The scope is to inform the assignee on the maximum distance between the electronic nose and the chamber. If they are more than 2mt distant the electronic nose cannot sample the odor. Main failure causes (why): The operator is not informed on the parameters to be respected.							
Reporter	SACMI		Assignee	ALL				
Priority	<i>Essential</i>	No	<i>Major</i>	No	<i>Medium</i>	Yes	<i>Optional</i>	No
Date (change history)	10.12.2018.							

RQ ID	SC-T-08	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	The electronic nose shall be powered using an external stable power supply							
Rationale (why, what, how)	An external stable power supply (220V, 50 Hz, max power consumption required 200W) shall be involved within the sub-system and components. The operator shall be informed on the parameters to be respected (220 V 50 Hz) since wrong values of the voltage or the current can damage the device.							
Reporter	SACMI		Assignee	FRAUNHOFER, ALPES, FILAR, PRIMA, BRIGHTERWAVE				
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	10.12.2018.							



RQ ID	SC-T-09	RQ Type	Technical			Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	N/A								
Title (Summary)	The device shall be placed on a flat surface; its size is 40x20x50 cm and it weighs 15-20 Kg.								
Rationale (why, what, how)	The scope of this requirement is to make awareness of the space required for the instrumentation, which include the electronic nose itself, the sampling chamber and a tube connecting the chamber and the instrument. If the room for the sensor is not adequate or the operator is not informed on the parameters and procedures to be respected the instrument will not work properly.								
Reporter	SACMI			Assignee			FRAUNHOFER, ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No	
Date (change history)	10.12.2018.								

5.6 FRAUNHOFER

Within the 1st iteration period, FRAUNHOFER has defined nine technical requirements. Their details are presented in respected sections.

5.6.1 Design and architecture of process chain and strategies

RQ ID	F-IOF-T-01	RQ Type	Technical			Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	N/A								
Title (Summary)	The process chain and strategy for all KPF and solution functionalities.								
Rationale (why, what, how)	Process chain architectures and strategies for photonics system assembly have to be transferred from standard, linear and sequential designs to a mixed architecture that contains feedback loops and interfaces to software intelligence. In particular emerging developments from Artificial Intelligence about planning and development of multi-variable processes shall be taken into account, respective interfaces to hardware process based functionalities have to be determined and qualitatively parametrized.								
Reporter	FRAUNHOFER			Assignee			FRAUNHOFER, FICONTEC, TUT		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No	
Date (history)	13.01.2019								



RQ ID	F-IOF-T-02	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	F-IOF-T-01							
Title (Summary)	The process chain architecture and strategy layer structure							
Rationale (why, what, how)	Process chain architecture and strategies for photonics system assembly shall contain three different layers representing different levels of details. The first, generalized and qualitative layer shall be composed of main process hardware/ software building blocks and interfaces, the second layer shall be quantitative in terms building block descriptions and main requirements, the third layer shall contain detailed quantitative requirements for building blocks and its sub-building blocks, and interfaces.							
Reporter	FRAUNHOFER			Assignee		FRAUNHOFER, FICONTEC, TUT		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	13.01.2019							

5.6.2 Process Chain

RQ ID	F-IOF-T-03	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	N/A							
Title (Summary)	Process chain building blocks and interfaces description							
Rationale (why, what, how)	A common descriptor for process chain building block properties and performances, either hardware or software based, shall allow for a unified solution functionality description as well as for a unified hardware and software interface description.							
Reporter	FRAUNHOFER			Assignee		FRAUNHOFER		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	13.01.2019							

RQ ID	F-IOF-T-04	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	F-IOF-T-03							
Title (Summary)	Process chain hardware building blocks and interfaces description							



Rationale (why, what, how)	A common descriptor for process chain hardware building block properties and performances, shall allow for a unified solution functionality description as well as for a unified hardware interface description. The hardware descriptor shall focus on procedural, optical, mechanical, electrical, thermal, environmental, and assembly economics issues of the assembly chain.							
Reporter	FRAUNHOFER			Assignee		FRAUNHOFER		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	13.01.2019							

RQ ID	F-IOF-T-05	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	F-IOF-T-03							
Title (Summary)	Process chain software building blocks and interfaces description							
Rationale (why, what, how)	A common descriptor for process chain software building block properties and performances, shall allow for a unified solution functionality description as well as for a unified software interface description. The software descriptor shall focus on procedural and multi-parameter control, usability and inter-operability amongst different photonics assembly platforms.							
Reporter	FRAUNHOFER			Assignee		FRAUNHOFER		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (history)	13.01.2019							

5.6.3 Solution Validation

RQ ID	F-IOF-T-06	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	Solution validation based on functional parameters							
Rationale (why, what, how)	Individual solutions for the iQonic process chain shall be characterized by a matrix of KPF, independent from their application to individual use cases. Functionality test cases have to be defined that allow for simple, statistically reliable testing. In case functionality cannot be tested stand-alone, standardized interfaces to the process environment and control have to be defined, e.g. by defining hardware and/ or software simulators.							
Reporter	FRAUNHOFER			Assignee		FRAUNHOFER		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No



Date (change history)	13.01.2019							
RQ ID	F-IOF-T-07	RQ Type		Technical	Use Cases		generic	
Parent RQ	F-IOF-T-06							
Title (Summary)	Hardware process based solution validation based on functional parameters							
Rationale (why, what, how)	Hardware based process solution validation shall be defined in a way that statistically reliable testing can be done for a relevant number of processed samples. Procedures to evaluate the samples have to be defined. The samples shall reflect, if suitable, main features of user cases, but shall be independent for easier processing of in particular high numbers of samples for statistical reasons. If needed, a software simulator shall be used for the defined variation of software inputs.							
Reporter	FRAUNHOFER			Assignee		FRAUNHOFER		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	13.01.2019							

RQ ID	F-IOF-T-08	RQ Type		Technical	Use Cases		generic	
Parent RQ	F-IOF-T-06							
Title (Summary)	Software process based solution validation based on functional parameters							
Rationale (why, what, how)	For software based process solution validation a procedure following the guidelines of ISO/IEC/IEEE 29119 Software Testing standards shall be applied. Of particular interest is testing vs. a variability of hardware process parameter inputs, e.g. for range limits or out of bounds values, to prove stability of the software based process solution. If needed, a hardware simulator shall be used for the variation of these inputs.							
Reporter	FRAUNHOFER			Assignee		FRAUNHOFER		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	13.01.2019							

5.6.4 Use Case Demonstration Evaluation

RQ ID	F-IOF-T-09	RQ Type		Technical	Use Cases		ALPES, FILAR, PRIMA, BRIGHTERWAVE	
Parent RQ	N/A							
Title (Summary)	Evaluation performance methodology and requirements matrix							



Rationale (why, what, how)	The evaluation methodology shall be deterministic, addressing a matrix of KPF requirements for each use case. In the same time, the methodology shall be adapted to the individual use cases and their specific requirements. In particular, evaluation procedures and their boundary conditions, e.g. number of samples to be processed for reliable statistics, test procedures on the samples to prove their performance etc., shall be defined to allow planning for the use case providers. The methodology shall also provide information about the progress vs. state of the art.							
Reporter	FRAUNHOFER			Assignee		FRAUNHOFER		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	13.01.2019							

5.7 BRUNEL

In the first iteration BRUNEL sets ten technical requirements. These details have been reported in corresponding sections below.

5.7.1 Production Logic

RQ ID	BU-T-01	RQ Type	Technical		Use Cases #	ALPES, FILAR, PRIMA, BRIGHTERWAVE, Ficontec (All Manufacturers and OEMS)		
Parent RQ	N/A							
Title (Summary)	Full production process (Process Flow Chart), Precedence Chart, Station and Total production Cycle Times							
Rationale (why, what, how)	A full understanding of the production process described by OEM and the Manufacturer (each with their own interpretation and manufacturers with their interferences)							
Reporter	BRUNEL			Assignee		All Manufacturers and OEM		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	28.12.2018.							

RQ ID	BU-T-02	RQ Type	Technical		Use Cases #	ALPES, FILAR, PRIMA, BRIGHTERWAVE, Ficontec (All Manufacturers and OEMS)		
Parent RQ	N/A							
Title (Summary)	Full Description/Specification/Tolerances/Equipment/ of Production Processes							



Rationale (why, what, how)	A full understanding of the production process described by OEM and the Manufacturer (each with their own interpretation and manufacturers with their interferences). All necessary steps with clear indicators and measurements, tolerances, and all necessary technical details of processing that impact quality and material flow.							
Reporter	BRUNEL			Assignee		All Manufacturers and OEM		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	28.12.2018.							

5.7.2 Existing Machine State and Control Logic

RQ ID	BU-T-03	RQ Type	Technical		Use Cases #	ALPES, FILAR, PRIMA, BRIGHTERWAVE, Ficontec (All Manufacturers and OEMS), Shadow		
Parent RQ	N/A							
Title (Summary)	Process Control Architecture, Mechanisms, Logic, Process Capability, Sensors and Actuation							
Rationale (why, what, how)	<p>A full understanding of the production process control logic sensing and actuation. What if scenarios? Monitoring and Actuation Capabilities, flexibilities and constraints.</p> <p>This information linked to the quality evaluation and process capability will lead to identification of innovation steps for dexterity and flexibility in the production process (Shadow Robot)</p> <p>Result: Identification of Gap in technology</p>							
Reporter	BRUNEL			Assignee		All Manufacturers and OEM and Shadow Robot		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	28.12.2018.							

5.7.3 Product and Process Quality Monitoring

RQ ID	BU-T-04	RQ Type	Technical		Use Cases #	ALPES, FILAR, PRIMA, BRIGHTERWAVE, Ficontec (All Manufacturers and OEMS), Shadow		
Parent RQ	N/A							
Title (Summary)	Quality Control and Management							
Rationale (why, what, how)	Quality control techniques, on-line and off-line, reporting mechanism, corrective actions, feedback time, actions and reactions, tolerances, machine state and product quality links (if exists).							



Reporter	BRUNEL			Assignee		All Manufacturers and OEM and Shadow Robot		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	28.12.2018.							

RQ ID	BU-T-05	RQ Type	Technical		Use Cases #	ALPES, FILAR, PRIMA, BRIGHTERWAVE, Ficontec (All Manufacturers and OEMS), Shadow Robot		
Parent RQ	N/A							
Title (Summary)	Machine State and Product/Process Quality Mapping							
Rationale (why, what, how)	Detailed event analytics of the machine state and its relation with production quality. Real-time data acquisition capabilities, off-line quality assessments, expert views on types of defect and causal relations.							
Reporter	BRUNEL			Assignee		All Manufacturers and OEM and Shadow Robot		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	28.12.2018.							

RQ ID	BU-T-06	RQ Type	Technical		Use Cases #	ALPES, FILAR, PRIMA, BRIGHTERWAVE, Ficontec (All Manufacturers and OEMS)		
Parent RQ	BU-T-05							
Title (Summary)	Machine Maintenance and failure modes							
Rationale (why, what, how)	Reports and FMEA on machine tools failure, impact, risk and potential relationship between MTBF and quality assurance.							
Reporter	BRUNEL			Assignee		All Manufacturers and OEM and Shadow Robot		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No



Date (change history)	28.12.2018.
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5.7.4 Flexible, Predictive Manufacturing Platform

RQ ID	BU-T-07	RQ Type	Technical	Use Cases #	ALPES, FILAR, PRIMA, BRIGHTERWAVE, Ficotec (All Manufacturers and OEMS)			
Parent RQ	N/A							
Title (Summary)	Agile, Dexterous and Responsive Production System							
Rationale (why, what, how)	The new robotics, sensing and actuation technologies to be deployed for online predictive control system							
Reporter	BRUNEL			Assignee	All Manufacturers and OEM			
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	28.12.2018.							

RQ ID	BU-T-08	RQ Type	Technical	Use Cases #	ALPES, FILAR, PRIMA, BRIGHTERWAVE, Ficotec (All Manufacturers and OEMS)			
Parent RQ	N/A							
Title (Summary)	Agile, Dexterous and Responsive Production System							
Rationale (why, what, how)	The new robotics, sensing and actuation technologies to be deployed for online predictive control system							
Reporter	BRUNEL			Assignee	All Manufacturers and OEM			
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	28.12.2018.							

5.7.5 Circular Economy Modelling

RQ ID	BU-T-09	RQ Type	Technical	Use Cases #	ALPES, FILAR, PRIMA, BRIGHTERWAVE, Ficotec (All Manufacturers and OEMS)			
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Parent RQ	N/A							
Title (Summary)	Principles of Circular Economy embedded in Manufacturing Control and Planning							
Rationale (why, what, how)	Understanding of the material evolution throughout production process, post production and reusability/recyclability							
Reporter	BRUNEL			Assignee			All Manufacturers and OEM	
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	28.12.2018.							

RQ ID	BU-T-10	RQ Type	Technical	Use Cases #	ALPES, FILAR, PRIMA, BRIGHTERWAVE, other partners involved in Reverse logistics and DSS (e.g. Atlantis)			
Parent RQ	N/A							
Title (Summary)	Production Economics, Environmental Impact Analysis, Logistics and Reverse Logistics							
Rationale (why, what, how)	Full EIA of the production system and end products, production, recycling and reusability economic and sustainability analysis. Understanding the practical and technological barriers and suggestions for overcoming them.							
Reporter	BRUNEL			Assignee			All Manufacturers and OEM	
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	28.12.2018.							

5.8 CORE

In the first iteration CORE sets requirements six technical requirements to the Early Malfunctional detection and prediction interface engine.

5.8.1 Early Malfunctional detection and prediction interface engine

RQ ID	CO-T-01	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	The machine learning algorithms must have access to synchronized data (common timestamp).							



Rationale (why, what, how)	The common timestamp will ensure that the data from the sensors and machines can be properly matched with each other to identify anomalies.							
Reporter	CORE			Assignee		HOLONIX, ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	21.12.2018.							

RQ ID	CO-T-02	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	CO-T-01							
Title (Summary)	Definitions of Normal Operation state and Anomaly state.							
Rationale (why, what, how)	The data must be provided with labels that explicitly describe the state of the machine at every timestamp or at least when it operated with erroneous conditions (can be time range instead of singular timestamps – start/end).							
Reporter	CORE			Assignee		HOLONIX, ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	21.12.2018.							

RQ ID	CO-T-03	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	CO-T-02							
Title (Summary)	Definitions of the types of the errors in the Anomaly state.							
Rationale (why, what, how)	The data must be provided with labels that explicitly describe the type of error (alarm codes, quality of the products, type of malfunction, etc.) when in Anomaly state, or suitable metadata formats (fused expert knowledge).							
Reporter	CORE			Assignee		HOLONIX, ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	21.12.2018.							



RQ ID	CO-T-04	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	N/A							
Title (Summary)	Specifications of communication protocols.							
Rationale (why, what, how)	This will allow to adapt the inference modules integration to every use case scenario.							
Reporter	CORE			Assignee		ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	21.12.2018.							

RQ ID	CO-T-05	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	N/A							
Title (Summary)	Specifications/definitions of machine cycles in each end user scenario.							
Rationale (why, what, how)	The duration of production the completes a machine cycle, which is necessary when designing machine learning algorithms to predict the future states.							
Reporter	CORE			Assignee		ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	21.12.2018.							

RQ ID	CO-T-06	RQ Type	Technical		Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	N/A							
Title (Summary)	Specifications and documentation of the historical data.							
Rationale (why, what, how)	To design proper machine learning algorithms with increased interpretability by the end users, expert knowledge of the data (what, why, how, etc.) needs to be provided by the end users in the form of documentation.							



Reporter	CORE			Assignee		ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	21.12.2018.							

5.9 TUT

In the first iteration TUT sets requirements four technical requirements. Their details are presented below.

5.9.1 Sensitivity, Geometry, Material, Size definition for assembly and disassembly

RQ ID	TA-T-01	RQ Type	Technical		Use Cases #	ALPES. FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	N/A							
Title (Summary)	Prototyping micro-optics assemblies							
Rationale (why, what, how)	A versatile and easily reconfigurable platform is needed to demonstrate many different types of zero-defect micro-optics assemblies for relatively small quantities (from several to some tens of assemblies). In order to define new assemblies fast, the platform should have advanced (semi) automatic calibration routines to define reference positions for the tooling and work benches. Moreover, the calibration routines could include visual or electronic inspection and recognition of tooling based for example on QR codes, visual inspection vs library or electronic IDs to verify correct tooling and quickly recalibrate their positions. The assembly system software should enable efficient teaching of motion trajectories using manual position guidance supported by cameras in a 3D environment.							
Reporter	TAU			Assignee		FRAUNHOFER		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	19.12.2018							

RQ ID	TA-T-02	RQ Type	Technical		Use Cases #	ALPES. FILAR, PRIMA, BRIGHTERWAVE		
Parent RQ	TA-T-01							
Title (Summary)	Metrology enhanced tooling for UV-bonding							



Rationale (why, what, how)	In order to mitigate the alignment issues caused by the shrinkage of UV-adhesives, the movement during the curing could be traced by measuring the relative position of the fastened optical component using optical interferometry. Recorded movement may indicate that the gluing process is defective and the output may not fulfill quality requirements. Furthermore, metrology enhanced tooling can adaptively compensate the movement during the UV-curing. Such functionality would allow faster set-up time and lower prototyping cost as one could simply measure glue shrinkage for each assembly component rather than to find out it through iterative process. Moreover, in production environment tooling could be used to monitor if glue shrinks in a constant way from day to day – this could be great help for zero defect manufacturing to find defective components. Practical realizations of this type of tooling include various different optical metrology instruments like for example different type of imaging or non-imaging interferometers.							
Reporter	TAU			Assignee		FRAUNHOFER		
Priority	<i>Essential</i>	No	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	Yes
Date (change history)	19.12.2018							

RQ ID	TA-T-03	RQ Type	Technical		Use Cases #	ALPES. FILAR, PRIMA, BRIGTERWAVE		
Parent Requirement #	TA-T-01							
Title (Summary)	Die/submount bonding							
Rationale (why, what, how)	Die/submount bonding with thin, uniform, and flux-free solder is required to achieve high reliability and low thermal resistance between the die and the heat sink. Moreover, after the die/submount bonding process, the solder joint quality must be investigated in order to avoid solder joint failures. The possible reworking, if the soldering process turns out to be defective, damaged, or misplaced, should follow the inspection. Scenario where soldered submount is reworked is realistic in any environment. Self-alignment of solder bond based on pattern defined on wafer level could improve zero-defect manufacturing in certain cases where tightest possible alignment is required and active alignment is not possible. This could be for example when bonding together laser diode chip on silicon photonics platform.							
Reporter	TAU			Assignee		FRAUNHOFER		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	19.12.2018							

RQ ID	TA-T-04	RQ Type	Technical		Use Cases #	ALPES. FILAR, PRIMA, BRIGTERWAVE		
Parent Requirement #	AT-T-07							



Title (Summary)	Insitu testing of a chip, bar or submounted light source							
Rationale (why, what, how)	Insitu testing of components enables to identify a defective light source, to address the source causing the indicated defect, and to define the possible changes in the supply chain. The insitu testing is carried by beam diagnostic tool (BDT) that supports both testing and assembly.							
Reporter	TAU			Assignee			FRAUNHOFER	
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	19.12.2018							

5.10 POLIMI

In the first iteration POLIMI has identified thirteen technical requirements presented in the sub-sections below.

5.10.1 Evaluation of functionalities and downstream strategies

RQ ID	PO-T-01	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	Definition of technically feasible defect management strategies.							
Rationale (why, what, how)	The identified defect management strategy that will be defined for each defect type, selecting among (i) defect repair by downstream compensation, (ii) disassembly for direct reuse of components, or (iii) disassembly for reuse through remanufacturing and regeneration, shall be technically feasible, meaning that the required skills, technologies, tools and methods shall be accepted by the end-users.							
Reporter	POLIMI			Assignee			ALPES, FILAR, PRIMA, BRIGHTERWAVE	
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	20.01.2019.							

RQ ID	PO-T-02	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	PO-T-01							
Title (Summary)	Defect repair by downstream compensation							



Rationale (why, what, how)	A model-based approach for the determination of compensation variables and entities shall be applicable to the end-user case, and the nominal process settings shall be adjustable depending on the conditions of the defective part.							
Reporter	POLIMI			Assignee		ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	20.01.2019.							

RQ ID	PO-T-03	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	PO-T-01							
Title (Summary)	Disassembly for direct reuse of components.							
Rationale (why, what, how)	The functionality of the reusable component shall be preserved after the disassembly process, meaning that non-destructive disassembly shall be applied.							
Reporter	POLIMI			Assignee		ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	20.01.2019.							

RQ ID	PO-T-04	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	PO-T-03							
Title (Summary)	Component design for non-destructive disassembly.							
Rationale (why, what, how)	The component suitable for reuse should be designed with the purpose to be reversibly disassembled, meaning that irreversible joints, such as glue and welding, should be absent.							
Reporter	POLIMI			Assignee		ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No



Date (change history)	20.01.2019.							
RQ ID	PO-T-05	RQ Type		Technical	Use Cases		ALPES, FILAR, PRIMA, BRIGHTERWAVE	
Parent RQ	PO-T-01							
Title (Summary)	Disassembly for reuse through remanufacturing and regeneration.							
Rationale (why, what, how)	Remanufacturing and regeneration should be technically feasible and should preserve the functionality of the component.							
Reporter	POLIMI			Assignee		ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	20.01.2019.							

RQ ID	PO-T-06	RQ Type		Technical	Use Cases		ALPES, FILAR, PRIMA, BRIGHTERWAVE	
Parent RQ	PO-T-05							
Title (Summary)	Remanufacturing of components for reuse.							
Rationale (why, what, how)	Remanufacturing should bring back the quality and the geometry of the component to the “as good as new” conditions.							
Reporter	POLIMI			Assignee		ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	20.01.2019.							

RQ ID	PO-T-07	RQ Type		Technical	Use Cases		ALPES, FILAR, PRIMA, BRIGHTERWAVE	
Parent RQ	PO-T-05							
Title (Summary)	Remanufacturing of components for reuse.							



Rationale (why, what, how)	The remanufacturing process should be less energy intensive than the production of the new component, should be less expensive, and accepted by the customer.							
Reporter	POLIMI			Assignee		ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	20.01.2019.							

RQ ID	PO-T-07	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	PO-T-05							
Title (Summary)	Re-assembly after regeneration.							
Rationale (why, what, how)	The regeneration process should provide a component that is in specification and of sufficiently good quality to support re-assembly.							
Reporter	POLIMI			Assignee		ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	20.01.2019.							

5.10.2 CPS for product reuse and requalification

RQ ID	PO-T-08	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	Cyber-physical system (CPS) architecture definition.							
Rationale (why, what, how)	The architecture of the CPS should be properly integrated within the iQonic system architecture.							
Reporter	POLIMI			Assignee		FRAUNHOFER		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	20.01.2019.							



RQ ID	PO-T-09	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	PO-T-08							
Title (Summary)	CPS data gathering module.							
Rationale (why, what, how)	The data gathering module of the CPS shall be connected to the Knowledge Base System (KBS) to continuously receive in input updated information about the product at the previous production stages before requalification.							
Reporter	POLIMI		Assignee	HOLONIX				
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	20.01.2019.							

RQ ID	PO-T-10	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	PO-T-08							
Title (Summary)	CPS intelligent data analysis module.							
Rationale (why, what, how)	The intelligent module of the CPS, where the most proper solution for requalification is selected depending on the product conditions, should guarantee a computational time that is shorter than the lead time between the stage where data are gathered and the stage where the requalification takes place (requalification does not create blocking).							
Reporter	POLIMI		Assignee	HOLONIX				
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	20.01.2019.							

RQ ID	PO-T-11	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE
Parent RQ	PO-T-08				
Title (Summary)	CPS actuation module.				



Rationale (why, what, how)	The CPS should influence the quality characteristics of the component by acting automatically or manually on the downstream process parameters.							
Reporter	POLIMI			Assignee		HOLONIX		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	20.01.2019.							

RQ ID	PO-T-12	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	PO-T-08							
Title (Summary)	CPS data exchange.							
Rationale (why, what, how)	The data exchange protocol among the physical layer and the digital layer of the CPS should be based on machine-to-machine communication standards such as OPC-UA.							
Reporter	POLIMI			Assignee		HOLONIX		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	20.01.2019.							

RQ ID	PO-T-13	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	CPS Human-machine Interface (HMI).							
Rationale (why, what, how)	The HMI reporting to the operator the suggested requalification for re-use action shall make it possible to (i) report to the operator the defect cause and the suggested correction action, (ii) suggest to the operators specific procedures for requalification depending on the component defect entity, (iii) let the operator accept the suggested strategy or manually select a different strategy for requalification.							
Reporter	POLIMI			Assignee		ALPES, FILAR, PRIMA, BRIGHTERWAVE		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No



Date (change history)	20.01.2019.
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5.11 FORTH

In the first iteration FORTH have defined one technical requirement presented in the sub-section below.

5.11.1 The adaptive in-process optics for real time and thin layer quality inspection

RQ ID	FO-T-01	RQ Type	Technical	Use Cases	ALPES, FILAR, PRIMA, BRIGHTERWAVE			
Parent RQ	N/A							
Title (Summary)	Definition of the “defects” that will be imaged.							
Rationale (why, what, how)	The identification of the parameters that affect the image quality will apply to the optical correction strategy. This shall dictate the adjustment of the adaptive optics imaging setup to meet the optical demands of those corrections. Consequently, the definition of the “defects” that will be imaged, shall provide the base for the calculation and implementation of the optical parameters correction.							
Reporter	FORTH		Assignee	ALPES, FILAR, PRIMA, BRIGHTERWAVE				
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	29.12.2018.							

5.12 SHADOW

In the first iteration period, SHADOW summarised a requirement as a business / not applied specifically to the project. As they need Demo Site requirements first, this RQ will be re-evaluated, edited and refined as the project evolves.

5.12.1 General

RQ ID	SRC-T-01	RQ Type	Technical	Use Cases #	ALPES. FILAR, PRIMA, BRIGTERWAVE
Parent Requirement #	<p>Shadow Robot requirements list for ICONIQ project</p> <p>Shadow designs and manufactures state-of-the-art anthropomorphic robot hands & related systems. We’re one of Britain’s longest-running robotics firms and the leading experts for technology around grasping and manipulation for robotics.</p> <p>For the project we are proposing to use a hand attached to an arm in order to manipulate electronic components or tools.</p> <p>One of our grippers look like the picture below:</p>				



A break down of the system to assess the requirements can be found below:

Hardware list:

Robotic Hand (Dexterous Hand)
Robotic Arm ([UR10](#))
Computer to operate the hardware

Arm Specifications (UR10):

Payload: 10KG
Reach: 1300mm
Weight: 33.5KG
Footprint: 190mm

Hand specifications:

Weight: 4.2KG
Communication: Ethercat protocol through LAN
Joint speed from min to max: 1hz
Materials: aluminium, brass, acetyl, polycarbonate and polyurethane flesh
Joint position sensing: 0.2 degrees
Power consumption: 48V 2.5A

Computer specifications and software:

The Shadow Dexterous Hand will be supplied with a powerful computer that runs Linux (Ubuntu 16.04) and is fully compatible with ROS (Robot Operating System www.ros.org) providing a full range of capabilities including:

- Control
- Visualisation
- Simulation

All of the software is based on ROS and allows communication with other platforms and modules. Most of the control software is written in Python



Title (Summary)	General Requirement and specification							
Rationale (why, what, how)	This provides a summary of requirement for Shadow as a business / not applied specifically to the project as we need Demo Site requirements first							
Reporter	Shadow			Assignee				
Priority	<i>Essential</i>	<x>	<i>Major</i>	<x>	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	<List history of changes to this requirement>							

5.13 IP-ASCR

HiLASE centre (part of IP-ASCR) is focused on development of high intensity diode pump solid state lasers (DPSSL) with short (ns) and ultra-short (ps) pulses. They have defined four business requirements.

5.13.1 High intensity diode pump solid state lasers (DPSSL)

RQ ID	IP-B-01	RQ Type		Business		Use Cases	HiLASE	
Parent Requirement	FI-B-01, FI-B-02							
Title (Summary)	Selection of laser gain media and coatings							
Rationale (why, what, how)	In cooperation with FILAR select materials and coatings of main importance. Based on this selection, define KPF. According to existing knowledge propose most critical parameters in production chain and propose way of documenting them.							
Reporter	HiLASE			Assignee			FILAR	
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	17.01.2019							

RQ ID	IP-B-02	RQ Type		Business		Use Cases	HiLASE	
Parent Requirement	FI-B-01, FI-B-02							
Title (Summary)	Influence of mechanical processes to coatings quality on laser gain media							



Rationale (why, what, how)	Based on experience, HiLASE team recognized that all mechanical processes (cutting, grinding, polishing, and cleaning) are strongly influencing final performance (LIDT as well as operation in the laser system) of laser gain media. In line with mentioned we propose to define KPFs, propose way of surface inspection after each mechanical process and document them.							
Reporter	HiLASE			Assignee		FILAR		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	17.01.2019							

RQ ID	IP-B-03	RQ Type		Business		Use Cases	HiLASE	
Parent Requirement	FI-B-01 and-02, IP-B-01 and -02							
Title (Summary)	Testing of coated surfaces quality of laser gain media for laser applications.							
Rationale (why, what, how)	Prepared laser gain media (with well documented production parameters in each production step) will be tested at HiLASE for LIDT (with HiLASE laser systems) and their performance will be investigated in some real laser systems. Performance of laser gain media will be correlated with production parameters. In order to produce laser gain media with defined KPFs, it will be selected a way of improvements in each production step and will be designed monitoring and control systems.							
Reporter	HiLASE			Assignee		IQONIC Consortium		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	17.01.2019							

RQ ID	IP-B-04	RQ Type		Business		Use Cases	HiLASE	
Parent Requirement	IQONIC system testing on production of thin-disk head							
Title (Summary)	Production of thin-disk head							
Rationale (why, what, how)	Production of thin-disk head is very complex with very low rate of success. Therefore, production of one head can take several months. This production can strongly benefit from usage of IQONIC system while many similar problems (glue shrinking during bonding for example) will be addressed.							



Reporter	HiLASE			Assignee		IQONIC Consortium		
Priority	<i>Essential</i>	Yes	<i>Major</i>	No	<i>Medium</i>	No	<i>Optional</i>	No
Date (change history)	17.01.2019							

6 Conclusion and next steps

User requirements from industry, technical and research partners have been consolidated within the first iteration period (M01-M04) of this task and reported in this deliverable. The use cases, technical objectives and technologies that were defined in the proposal phase of this project, have been considered and served as a guideline during this first definition and collection process. Further on, technical objectives will be validated by technical and research partners and finalised (if necessary) after the revision of RQs due M20 and any updates or changes will be reported in D2.5. Also, the use case elaboration will be finalised upon end-users input analysis in M05 and reported in respective deliverable D2.4. Furthermore, the second (M12-M14) and third (M18-M20) iteration periods of the task will be used for reporting new RQs and quality checks in general. All RQs will be re-assessed during the two last iteration periods and refined if necessary, specifying in details pre-known conditions, criteria - target that makes it possible to test, exceptions that should be handled and listing other dependencies (if any). The RQs will be used for the design of components within WP3-WP6, obtaining the users feedback, updating the requirements that will retrofit and improve s/w and process chain designs within iQonic solution. These elaborations will provide guides to consortium on how to build the iQonic system and how shall the general iQonic solution be applied within the optoelectronics industry in the future.

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