



“Flexible and on-demand manufacturing of customised spectacles by close-to-optician production clusters”

Final Publishable summary

Project title: Flexible and on-demand manufacturing of customized spectacles by close-to-optician production clusters

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1. Final publishable summary report

1.1 Executive summary

Optician2020 - Flexible and on-demand manufacturing of customized spectacles by close-to-optician production clusters - is a 3-year-project co-funded by the European Commission within the Factories of the Future initiative of the 7th Framework Programme.

The project addresses the need for new manufacturing technologies for the local production of personalised spectacles, based on refractive prescription, customers' anatomical data and their aesthetical preferences. Optician2020 has developed the technologies and processes necessary to demonstrate that the personalised spectacles business can be fashionable and, at the same time, a sustainable and profitable proximity manufacturing industry.

Key technologies enabling the Optician 2020 model have been successfully developed including an advanced user data capture device and co-design SW, automated procedures to personalised spectacles design, advanced manufacturing technologies adapted to the produce personalised products and ICT tools for the mini-factories networks management. The Optician 2020 novel paradigm has been demonstrated by means of two mini-factory networks located in Southern Europe and Central Europe, generating more than 450 personalised spectacles for real users. Besides, studies have been produced for smoothing the industrial scalability of the model, as well as assessing the environmental impact of this new model.

Demonstration has validated the sustainability of this novel business model in terms of personalisation flexibility, fast delivery and environmental friendly productions, bringing out important benefits for both the industrial sector and consumers.

Optician 2020 impacts the industry with important economic and environmental aspects, reducing time-to-market (75% reduction), achieving competitive delivery times (23 days and 15 days foreseen) and reducing the environmental footprint (50-62%) compared to conventional processes for manufacturing spectacles. It also impacts the society with great benefits for the consumer, such as better purchase experience, improved ergonomic comfort and aesthetics, better optical quality and providing him with an exclusive and fashionable product.

All these outcomes and results have been widely disseminated by means of communication materials, press, and presentations at several events to give to the Optician2020 solution the necessary visibility and credibility to facilitate market uptake. The dissemination activities have proven effective and have led to a great impact on media and target audience, as well as it has caught the attention of interested companies in Optician 2020 business model.

1.2 Summary description of project context and objectives

Optician2020 addresses the need for new manufacturing set-ups that perform as de-localized mini-factories, for an affordable supply of personalised spectacles. Design, manufacturing and supply processes will be developed which will provide the required capabilities for the local production of personalised spectacles. Key to this approach is the use of Additive Manufacturing (AM) technologies able to process polymeric and metallic materials for the frames production, and the implementation of a dedicated business model for the sustainable and profitable manufacturing system based on mini-factories.



Optician2020 aims at demonstrating the sustainability of a novel business model for personalised spectacles delivery through a proximity production network performing as local mini-factories. Sustainability is the key driver behind Optician2020 project, understood in terms of cost-efficiency, fast delivery and environmentally friendly solutions.

The specific objectives of the project are as follows:

Specific technological objectives:

- To develop enabling technologies for the full personalisation of spectacles: design and manufacturing technologies for metallic and polymeric framed spectacles.
- To develop an intelligent open network of de-localised virtual mini production centres with the necessary protocols and ICT tools for an efficient and flexible management.
- To test and validate the quality of the manufactured personalised spectacles.
- To test and validate the robustness of the Optician2020 mini-factories network.

Specific demonstration objectives:

- To demonstrate the spectacles personalisation flexibility by developing a catalogue of at least 12 models to be personalised in spectacles for 450 users from different EU cities.
- To demonstrate the mini-factories flexibility and re-configurability. An agile procedure for adding new local manufacturing facilities to the open virtual network will be shown, allowing for a fast response to market dynamics.
- To demonstrate a time to market reduction up to 65% and a production cost reduction of 40% with respect to conventional methods.
- To demonstrate the environmental efficiency of the mini-factories production model by a 50% of footprint reduction.

1.3 Description of main S&T results/foregrounds

The main results of the Optician project can be grouped in the following categories:

Personalised design procedures

The objectives addressed in this area were to develop technical solutions to make possible the design of the personalised spectacles (frame and lens) to be produced: a user-face data capture device and automated procedures to create a spectacles catalogue and adapt them to each individual user.

At the end of the project, the outputs are:

- An user facial data capture device and a front-end software, the so called co-design, including a virtual try-on that matches accuracy requirements for spectacles personalisation.
- Procedures for the design of parametric frames that allow the personalization even of complex geometries.
- Automatic procedures and service for the calculation of personalized frames and lens for each user data input.
- A complete catalogue of personalisable frames and lenses to be used in the project demonstrations.



Personalized Manufacturing technologies

Work in this area has been focused on setting-up the equipment and processes for an efficient personalisation of spectacles considering aspects such as short series sustainability, automation and reliability while complying with the final product functional and aesthetic quality standards.

Main results in this area are:

- Development and demonstration of procedures for the manufacture of customizable spectacle frames through laser sintering of polyamide powder, including appropriate surface finishes, a coloured dye method with a range of colour options for decoration of spectacles, traceability and optimization of the procedures.
- Development and demonstration of procedures for the manufacture of Titanium customizable spectacle frames through Selective Laser Melting technologies, including the identification of critical aspects for the manufacturing and suitable typology of frame and hinge designs, selection of material, the determination of finishing procedures to be used in Optician2020 (matte and glossy), traceability and optimization of the procedures.
- A coating process workflow has been established and new machines and processes for the differently coloured lenses and their anti-reflective coatings as well as the processes for the mirrors with different colours have been developed and set up. A colour space with 5 different colours and 4 different transmittances was defined for its use in the project.
- Assembly workflows and procedures have been identified, defined and tested, including frame tracing, lens edging, the assembly of metallic and polymeric frames, and the lens assembly in metallic frames (using Nylon wire) and in polyamide (via bevel finishing).

Mini-factories Network Development

The objective in this area was to develop a web-based platform and a set of computational services to automate the design, manufacturing and logistics regarding the personalised spectacles.

Optician 2020 has designed and developed an ICT Management Platform for the mini-factory deployment including:

- Design of a networked architecture: functional modules and detailed data model to be used in the IT platform, which are based in modern systems design principles (REST, service-oriented).
- Scalability report including guidelines for validating mini-factory performance, scaling to new production assets, and an analysis of the potential applicability of the mini-factory concept to other sectors.
- Development of a back-end architecture which allow technical information about a product to be accessed dynamically, allowing a layered approach for building up product specifications.
- Development of the front-end networked architecture which allow the different players in the value chain to access to the IT platform provided services (design of personalised spectacles, monitor the spectacles production, etc.)

Industrial Scalability

Main target in this area was to perform the necessary studies for a smooth industrial scalability of the Optician 2020 outcomes covering geographical deployment, environmental impact assessment and regulation aspects. As a result of the work on this area:

- A production transfer guide has been created which defines industrial supplier profiles of different supply chains defined according to several market scenarios, establishing clear



criteria and requirements regarding the equipment parameters and parts quality to be accomplished by new production sites.

- An environmental assessment tool has been created and integrated into the ICT platform that allow to evaluate the impact of each individual spectacle. Based on resulting data, an environmental study have been created after the demonstration stage showing that the production of spectacles based on advance manufacturing processes represents a decrease of the environmental footprint in a range from 50-62% in the best cases depending on the model and material used, fulfilling one of the expected impacts of the project.
- The complete set of European and International standards and regulations that apply to personalised spectacles have been identified and analysed. Tests have been performed to validate Optician2020 compliance with regulations. Actions to be carried out by the manufacturer in order to comply with the regulations have also been indicated.

Mini-factory demonstration

The goal of this demonstration activity was to validate and show the mini-factory potential in delivering personalised spectacles in a first proximity cluster.

Optician 2020 set up a cluster in Southern Europe and prepared all the materials and build the needed equipment for the manufacturing of the spectacles.

In these activities, Optician 2020 partners have validated the mini-factory potential for producing personalised spectacles, as well as the personalisation flexibility through the manufacturing and delivery of 240 personalised spectacles for real users of the optic shop in Portugal.

Besides, it has been demonstrated the consumer's and optician's acceptance of this new business models by means of extensive surveys to consumer's and opticians involved in the demonstration. Feedback collected from real users corroborate that Optician 2020 has created a more appealing shopping experience, where the final product perfect fits the consumer face, achieving high levels of satisfaction, quality perception and comfort perception and solving main problems when buying convectional spectacles such as frame adjusting, annoying nose pads or pressure on ears . "Optician 2020 spectacles better suits me" and "Optician 2020 lens provide a better comfort" are common statements heard from customers during demonstration.

Networked Mini-factories demonstration

Demonstration activities in this area were focused to validate the mini-factories paradigm in a second proximity cluster and demonstrate the expected benefits of this model compared with conventional spectacles production process.

The main achievements in this area are:

- Demonstrated the mini-factory's scalability by engaging a second optician (in Switzerland) and an additional lens production site (in Slovenia) as part of the second proximity cluster for Central Europe.
- Demonstrated the automated auto-configurability of the network to the dynamics of the different points of demand and the production sites availability, by adding new purchase order generation sites and additional manufacturing routes.
- Manufacture and delivery of 215 personalised spectacles for an equivalent number of users that were scanned at the optician shop in Switzerland.
- Demonstrated the benefits of the proximity manufacturing in terms of eco-impact, delivery time and flexibility:



- Mini-factories can deliver the personalised spectacles in a competitive time frame (less than 25 days) and foresees delivery times of less than 15 days.
- Optician 2020 business model can reduce the time-to-market of new personalised spectacles to 75% when compared to stock conventional frames.
- The manufacturing of personalized products by means of 3D printing technologies and local manufacturing can reduce the eco-cost up to a significant 50-62% in the best case when compared to traditional processes.

1.4 Potential impact and main dissemination activities and exploitation results

Optician 2020 proposed business model was born with the aim of impacting at different levels: economic, environmental level, and social thanks to its competitive advantages compared to traditional mass production manufacturing, which are:

- Complete personalised spectacles available for the first time.
- Product flexibility-shorter time-to-market: Catalogue easy to update.
- Local manufacturing for consumer proximity.
- Shorter manufacturing time: no big batches, no manufacturing tools
- Highly scalable business model via mini-factories spreading via existing suppliers: free-form RX labs and AM manufacturers.
- Higher added-value for all relevant actors within the supply chain.

Optician2020 has been highly successful in its efforts to meet the complex and ambitious scientific, technological and industrial challenges. Key enabling technologies have been developed that meet the needs of the Optician2020 solution. Demonstration activities have allowed to validate that the technical outcomes effectively result in the expected impacts listed below.

Economic & Environmental Impacts

- Time-to-market reduction of 75% compared to conventional processes:
 - Less time invested in the new models creation and validation.
 - Simplified catalogue building, the intelligent ICT management tools and the flexible production technologies used.
- Mini-factories access protocols allows a new mini-factory set-up in 2 months thanks to the incorporation of new existing production sites able to produce frames and lenses.
- Environmental footprint reduced 15-65% mostly due to transportation logistics savings and a more efficient use of raw materials.

Social Impact (from a consumer's point of view)

- Improved ergonomic comfort of the personalized frame. No annoying nose pads.
- Better optical quality of the personalized lens.



- Improved aesthetics because most personalized lenses are thinner and lighter than conventional ones.
- Exclusivity and fashion is made compatible with personal design choice.

Furthermore, through all dissemination activities, which will expand beyond the project duration, Optician 2020 has and will boost the local-proximity impact in the industrial community and wide public. Dissemination activities have been essential to give the Optician2020 solution the necessary visibility and credibility to facilitate market uptake. The dissemination objectives were accomplished and dissemination activities have proven effective. The Optician 2020 project has been very active in dissemination actions with the creation of several means of communication material and dissemination at events on order to raise awareness on the objectives, benefits and main results of the Optician2020 project. Dissemination activities have been intensive during the last months of the project once the demonstration activities begun and have led to a great impact on media and target audience, as well as it has caught the attention of interested companies in Optician 2020 business model.

Optician 2020 website, available since the very beginning of Optician2020 project, continuously updated with news and communication materials, has been the Optician 2020 flagship, together with Optician 2020's website at the EFFRA Innovation Portal. Several communication materials have been created to support dissemination activities: project presentation, Optician2020 leaflet and poster, the demonstration video, among others. Besides press notes explaining main achievements at different stages were released, communications through partner's newsletters, websites and Social Media channels (Twitter, Facebook) have been used to disseminate project results. Optician 2020 have also carried out more than 12 dissemination & networking events, presenting the project by means of talks, speeches, stands, etc. The project presence at these events has helped to spread the word about the project and its outcomes, to capture the attention of potential users and stakeholders, to present the results in more detail, to build a better relationship with interested attendees and to get valuable feedback and insights for the path to a future commercialization of project results. Among most recent events we can cite INDO's talk at the Future Industry Congress and Optician 2020 Pitch session at Factories of the Future Conference 2016 presented by Eurecat.

Thanks to all dissemination actions, the Optician project has had a great impact on the media with several appearances in media and press. Optician 2020 has got two main appearances at TV at Spain, a high number of newspaper articles published, both specific articles coming from interviews of event coverage as well as following the press note released. Based on press clipping during 2016 on Spanish media, Optician 2020 impacts have reached more than 1 Million people only on printed media and more than 1.3 Million on digital media, just in Spain.

Besides, its pro-active collaboration with the EFFRA provided also the attention of European organizations and companies. Just to mention the most recent impacts, in the recent Public-Private Partnerships Info Day, Optician 2020 was explicitly mentioned during the FoF presentation, and Optician has been invited by Chris Decubber (EFFRA) to be present at the final event of the FoF-Impact CSA with a small booth.



1.5 The Optician 2020 Consortium

Optician2020 consortium comprises 10 partners from 6 European countries: 2 RTD performing institutions, 5 SMEs and 3 LE representing the strong industrial involvement. It brings together a wealth of expertise and resources within the areas of advanced manufacturing, personalised design, knowledge-based engineering for production, sustainable industrial production technologies, anthropometrics and ergonomics of human-product interaction, all joint under the vision care industry.

Participant legal name	Short Name	Country	Organisation
Fundació Eurecat (CO)	EURECAT	ES	RTD
INDO OPTICAL S.L.U	INDO OPTICAL	ES	LE
Satisloh Photonics AG	SATISLOH	CH	LE
Knowledge Integration Ltd	K-INT	UK	SME
Optica Pita Lda	PITA	PT	SME
ALCOM OPTIKA DOO	ALCOM	SI	SME
Melotte nv	MELOTTE	BE	LE
Lens World SA	LENS	CH	SME
3TRPD LIMITED	3TRPD	UK	SME
Instituto de Biomecánica de Valencia	IBV	ES	RTD

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