Business Models for User Centred Products

Reporting

Project Information

MADE4U

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Final Report Summary - MADE4U (Business Models for User Centred Products)

Executive Summary:
MADE4U is a Collaborative Project that aims to research the key business and technology components for the production and bring-to-market of personalized spectacles. It is about the design & manufacturing of lenses and frames, and the identification of a suitable business-model for bringing these new products to market in sustainable fashion. The project was lead by the company Indo and gathered 13 European partners with more than 50 researchers during 48 months.

Personalization strategies allow manufacturers and marketers to offer products unique to end-user specifications and build them from the ground up to a given person?s needs and desires. In a personalized product environment, end-users typically participate in many steps of the product provisioning chain, usually from the beginning to the end.

During the four years of its life, the project has achieved the vast majority of our proposed objectives in terms of both, technologies advanced, proof of concept (demonstrator) and business models of flexible and easily reconfigurable supply chains with multiple contributors. It has also demonstrated a new user co-design buying experience that we strongly believe will be tomorrow?s trend with personalization of products at the forefront of value added commercial offerings.

Nowadays, there exist no proven technologies and methods that achieve a high degree of personalization of spectacles. Our proposed solution spans over the entire value- chain, also including the end-users themselves. Based on face and head morphology measurements, together with lens prescription data, the target pair of spectacles are automatically designed in 3D-CAD fashion and, selected by end-users, the precise lens and frame surface treatments and decoration.

The enabling technologies that were developed to manufacture such personalized spectacles are: laser sintering of polymeric materials, use of free-form lens generators, small batch surface treatments, and frame decoration with innovative 3D ink-jet printing techniques. During the last months of the project, we have set up a demonstrator of the technologies developed that was run in real conditions by two opticians who scanned 160 users that participated in the co-design process of their personalized spectacles. The spectacles were then manufactured by our de-localized network of partners and controlled with an Integrated Internet platform that supported the distributed manufacturing of the personalized spectacles.

The main conclusion of the project is that, although there are still many aspects to optimize, particularly costs and margins, some of the considered business models show that the concept appears quite promising. The demonstrator has identified a sufficient number of early adopters that positively assessed the fitting of the personalized spectacles and expressed strong willingness to purchase such highly differentiated product in the future.

Project Context and Objectives:
Background: In order to cope with the challenges of globalisation and the ever-increasing competition from low labour-cost countries, our European Industry needs to gradually establish new Business Models for bringing to market products with significantly increased value in the perception of consumers. It is generally recognized that, in order to persuade consumers about new added value, manufacturers will have to provide new product features, better quality and improved user experience.

For a large variety of consumer products one strategy to provide new added value is through Personalisation. With Personalisation producers make their products unique to end-user specifications because such personalized products are built from the ground up to a person?s special characteristics, needs and wants. In other words, with personalization the end-user of a product co-defines (participates in) the entire product provisioning process from beginning to end. On the contrary, Mass Customization, typically provides some illusion of personalisation as it permits the creation of customized product variants by enabling end-users to further enhance a standard product with features and components selected from a pool of available pick-and-choose building blocks.

There are quite a few known cases, as the particular one about spectacles that we shall be addressing in our proposed project, where it was found that personalisation achieves dramatically better results than mass customization. More specifically, it has been recently proven via R&D by Indo, the leading consortium partner of the current proposal that every human looks at surrounding objects via a unique combination of relative movements between one�s head and eyes. It was found that this phenomenon could be visually depicted (like in the case of fingerprints) by means of the so-called visual maps. Each map corresponds uniquely to a particular individual.

Concept: If available enabling technologies and economic conditions permitted, the ideal (most flexible and fastest responding to user needs) business model would be a two step process: a) User visits optician where prescription, visual strategy, face morphology, emotional and aesthetic requirements are measured/defined and choices are made (requirements acquisition) and b) Optician manufactures locally (in a matter of hours) a fully personalized pair of spectacles per the user specifications (manufacturing and assembly step).

If that were possible in practice (technologically and financially), opticians would be investing in two types of equipment, namely, measuring equipment for step (a) and manufacturing equipment for step (b). An optician�s typical suppliers would be a) blanks and consumables suppliers, b) measuring and manufacturing equipment suppliers and c) design knowledge suppliers. Knowledge suppliers are necessary to provide the CNC parameterization of the manufacturing equipment based on end-user specifications and measured data.

Currently, this model is not possible but it may eventually emerge as a result of the technological research in the subject matter. The reasons that this model is not feasible today is that a) lens cutting and treatment equipment is beyond the financial reach of Optician SMEs, b) available technologies for surface treatment (AR and hard coating) are only applicable to larger batches (60 items per phase), c) tinting technologies are almost handcrafted processes and d) there is no broadly used technique to manufacture and treat personalized frames. The only element of personalization of the ideal model that has sufficiently advanced is about lens geometry based on measured Visual Maps (achieved by INDO).

However, we consider the path to the ideal business model to be evolutionary through a transition process. In our project approach, although the measuring equipment would still be installed at an optician�s premises, it is most likely that the manufacturing equipment will be available at the so-called prescription labs (aka Finishing or RX-labs), which are larger size SMEs servicing many opticians. This will still need to be verified by the AVS business modelling methodology (that we shall apply to define optimal business models), however, our intuition suggests that at a first stage, because of the economics involved, opticians will need to rely on established RX-labs for some time in the future.

In conclusion, our project aims to research the key business and technology aspects for bringing to market highly personalised spectacles for people with (complex) visual disabilities. The objectives of the project will be therefore formulated in such a way that those key aspects are all properly addressed.

Consequently the envisaged final outcome of the project was a demonstrator system to test a particular scenario of a business model which will contain at least the following phases:

A series of end users came to an optic shop to acquire spectacles. The opticians (TIPHERET, PITA) took ergonomic measurements (studied previously by IBV with the help of INDO) of both the visual strategy (already existing technology and not subject to further advance by this project) and the 3D face geometry of the user via a device (hardware and software developed by IBV). The device enables the user for selection and co-design of the frame shape from a set of predefined families and of the decoration, taking into account aspects of emotional engineering and best fitting practices for the particular parameters of the specific face.

These measurements and options, along with the user prescription from existing records or measured by traditional methods, was then sent to the designer of the frame and lenses (INDO). INDO converted the measurements into machine parameters using automated design algorithms (developed by INDO using the conversion rules developed previously by IBV and INDO) for the design of the frame and the lenses including their decoration, tinting and surface treatments. The resulting machine parameters and electronic files drive then suitable machines for the production of a unique, personalised spectacle comprised of:

- The frame built via Rapid Manufacturing (developed and researched for adaptation to the generation of frame shapes by EOS) and its decoration via inkjet printing (developed by Xennia).
- The lenses including geometry by using existing free-form machines and polishing processes (already in place and not subject of further development in this project), the hard coat and anti-reflection coatings via sputtering (researched and developed by Satisloh with regards to small batch machine and INDO with respect to Hard coating and AR processes for the most common existing subtract materials). The lenses could undergo a colouring process developed by Xennia using inkjet techniques and newly developed inks.

Objectives: In accordance with the above, the objectives of the project are defined as:

A. To identify and evaluate systematically at least three potential business models used to bring to Market Personalized Spectacle products (frame mounted lenses) by using recent state-of-the-art Business Modelling Methods and Techniques.

i. To further expand the business modelling approach and make it generically applicable to other ophthalmic systems related market opportunities (e.g. motorbike helmets, sports related spectacles, or other lifestyle related usage), and similarly applicable to different Industries altogether.
ii. To thoroughly assess the risks and provide remedy strategies associated with the impact of potential dynamic/stochastic spreads of the fundamental parameters of the model that might occur in a projected product-lifecycle (see details in chapter 1.2.2)

B. To further research and advance most of the Technologies related to the Design and Manufacturing of Personalized Spectacles, as per the constituent components presented under Concept, (A) earlier in the current chapter (1.1).

C. To validate in practice one recommended Business Model (minimum) via a demonstrator system that can be thought of as a distributed network of market players (several of which are SMEs) interacting flexibly via standard industry inter-connections (Internet, B2B) in order to provide a flexible and easily re-configurable system for the production and sales of Personalised Spectacles.

Project Results:
Made4U is a highly innovative project. It deals with Business Models and its enabling technologies; 3D design of personalized spectacles, ink-jet, sputtering, laser sintering, polishing, etc Made4U is also about the automatic capture of user facial data, and frame co-design. Finally, Made4U is about a new and intelligent supply chain management applied to the customised spectacles production.

In this chapter we present the most relevant and innovative results that have been achieved during the project life. This information was extracted from the 59 deliverables produced during the course of the project.

WP1: Business Modelling

Business modelling is a methodology commonly used to innovate and transform established business, and eventually, create new ones. It deals with business models ecosystems that are characterized via its chain of partners, operations, value proposition, distribution and customer segmentation. Using the Added Value Stack® (AVS) methodology, we assembled the cost components of all chain processes and calculated the individual and consolidated Added Value Stacks. We also identified potential business risks from changes in the economic environment and the supply chain ecosystem. We subjected our models to variations of the key conditions and parameters, and forecast sustainability, expansibility and model robustness based on what-if simulations with inclusion and/or exclusion of chain processes, roles, actors and interfaces. We have finally performed stochastic projections of key value-chain parameters varying over time and selected a few recommended model(s) that we tested in the Demonstrator phase.

In summary, the main innovative results in our business modelling activity are:

 We have proposed 3 innovative Business Models to commercialize the personalized spectacles that were tested in the demonstrator stage of Made4U and differentiate in customer segmentation and the composition and location of the components of the added-value chain.

 According to data from demonstration the recommended Business Model 2 (lens and frame manufacture are centralized in a laboratory able to process 25.000 spectacles/yr from at least 110 to 160 opticians) provides a substantial potential benefit to the constituents of the AVS. The final sell price is in line with the high-end customer segment expectations.

 We have obtained the Added Value Stack (AVS) for each Business Model. The methodology and the mathematical approach that WP1 has used to simulate the AVS is highly innovative because it includes profitability analysis in terms of individual AVS component cost distribution. A technical paper describing the specific methodology and a case study was prepared.

The foreground generated has allowed one of the partners, the SME Braecis to set-up a methodology that can be applied to other businesses. The company has made a complete exploitation plan of this foreground that is available in the PUDF.

WP2: User Input Management

The aim of this Work Package is to develop effective and highly innovative customisation environments that will combine both, automatic and assisted co-design processes. In order to achieve that, we develop and structure the knowledge about new concepts of personalized visual systems.

This knowledge is based on a user-to-product interaction and on actual sales situations as described by opticians. It is also applied in the development of tools to capture user data, in the creation of a knowledge base for personalized product design, and in the development of tools and techniques to guide opticians and end-users through the entire design process.

The most relevant achievements are the ideation and implementation of a scan to capture the relevant information from user�s face to provide the input for the automatic calculation of the personalized spectacle and the assisted co-design software to convert the process of design of the spectacle components into an enjoyable purchase experience.

According to specific reference points related to head and face that we have identified, a device to automatically capture and process the 3D facial data was developed. The specifications in terms of data accuracy and usability of the apparatus were agreed with opticians and tested with a set of more than 400 individuals.

Finally, we created a software application that helps in the user co-design process to select the preferred combination of frame shape and decoration. It also helps to demonstrate the benefits of the different lens materials, designs and treatments. Both devices are highly innovative and essential to the success of the personalization of spectacles.

In summary, the main innovative results in the user data input management activity are:

� The user data-capture device was developed. It is a completely innovative device that provides the user morphological information required to personalize a frame. Two final prototypes were constructed and intensively tested in the period from February to May 2012 during the demonstration stage. The accuracy of the data provided by the scanning device is precise enough for the purpose of the virtual lens fitting. Users are positively surprised that the data capture process takes only a few seconds.

� The simulation of virtual try-on is visually attractive. The composition of the virtual rendered images of the frames and the pictures of the user face are realistic and credible. People perceive a clear image of the possible choices of spectacle shapes and decorations.

 The assisted co-design software is versatile; it combines an environment for self-selection of the frame decoration with a second module for the selection of the lenses which is optician-assisted.

The foreground generated has allowed one of the partners, IBV to create a device that can be used by other partners in the consortium to exploit the personalization of spectacles but could also be extended (with some modifications) to other business, like aesthetic cirugians, hairdressers, etc... The company has made a complete exploitation plan of this foreground that is available in the PUDF.

WP3: Automatic design

We have specified, developed and test an automatic design system for personalized ophthalmic lenses and frames. More precisely we created and implemented design tools and techniques which adapted pre-designed templates of frames, based on current fashion trends and brands, to a given individuals morphological characteristics (parameters) as well as aesthetic and emotional (personal) preferences. This process also involves choices of custom decorations and the necessary frame treatments per end-user preferences.
In summary, the main innovative results in the automatic design activity are:

 A catalogue of nine 3D personalized frames is now available for the first time with the capability to be modified within a wide range of dimensions, making the personalization available to a large number of possible users.
 The personalization algorithm shows good accuracy, particularly in the prediction of the intended wear position. This is also a breakthrough in personalization of spectacles.

 Lens geometry and optical performance can be optimised based on frame shapes in an innovative way. This research is protected with three patents and the commercial exploitation of the lenses in non-personalized frames is becoming very successful. Indo has sold more than 60.000 lenses of these innovative lenses in the last 18 months. This design was made for both single vision and also progressive lenses.

 Lens colour and reflection may also be personalized. A wide range of possible lens colour, reflectance and anti-reflectance is now available to complement the aesthetical offering of the lens personalization. The lambertian algorithm that generates a specific colour after combining the 4 base colours (CYMK) was also developed.
At the end of the project, we have produced two complete databases, one for frame designs and decorations and the other for lens designs and coatings. The software was prepared so each new frame and lens designer can provide their own database in a standardized format.
The calculation software is now centralized in 2 servers at Indo. In the future it may be hosted in the cloud and transformed in SaS.
The foreground generated has allowed INDO to create and exploit a new kind of lenses, Maxima, that is already commercializing, either as a finished product or indirectly as a digital lens calculation service. The company has also demonstrated interest in the exploitation of a complete personalized spectacle. The

company has made a complete exploitation plan of this foreground that is available in the PUDF.

WP4: Flexible manufacturing of lenses

With relation to lens coatings this Work Package aims to achieve integrated and automated tinting, hard-coating, Anti-Reflex or Mirror coatings and Top-Coating.

The Hard-Coating is applied by Spin Coating with UV-curable lacquers, which has advantages such as easy to be automated, single lens treatment, and fast production times. For lens tinting we initially planned to use ink-jet printing, nevertheless, we changed to spinning because of easy-of-use. We have sacrificed the possibility to apply gradient tints in the demonstrator (only 2% of current lens orders) to achieve a more performing and simple equipment. Anti-Reflex (AR) and mirror coatings are applied with a 4-lens batch sputtering process. Several AR colour and mirrors have been developed and are available for customer choice.

A specific recipe for each coating process was developed and samples of lenses coated with all these coatings have been produced and tested prior the demonstrator. During the demonstrator stage, more than 360 lenses have been coated with hardcoat, colored and AR or mirror coat according to the customer choices. The preferences of most customers are lens color rather than AR reflex color, while most of them would not be interested in designing a specific colour from scratch.

In summary, the main innovative results in the flexible lens manufacturing are:

 The prototype for coating ophthalmic lenses is able to apply good quality uniform tints. The colour prediction algorithm required to prepare the colour mixtures seems to be quite accurate. This is a breakthrough, since personalized tinted lenses are available for the first time.
 The sputter prototype able to obtain anti-reflective (AR) and mirror coatings is operative and performs according to specifications. A set of mirrors and AR coatings of different colors is available with recipes that provide good quality coatings.
 A hard coating spin coater has been also built that contains a cleaning module and a tint module. The achieved hard coatings have good uniformity, with good adhesion and abrasion resistance an all lens materials. The coating process is very fast, lasting only a few minutes whereas the conventional process takes several hours to complete the sample operations.

The foreground generated has allowed SatisLoh to create and exploit a new kind of lens coating systems that is willing to commercializing as a product for RX Laboratories. The company has made a complete exploitation plan of this foreground that is available in the PUDF.

WP5: Flexible manufacture of frames

The objective of this Work Package is to examine frame requirements and adapt current techniques and materials to the automatic production of personalized frames via Rapid Manufacturing processes. This means that have first researched and tested the capabilities of current state-of-the-art Laser-Sintering (LS) methods and related manufacturing equipment to meet design specifications for the production of durable spectacle frames. We then proceed to adapt existing LS processes, materials and methods in order to meet the specific product requirements related to the mechanical properties of the sintered frames, and also meet surface Finishing and decoration specifications.

We have set up the process for laser-sintering of polyamide, including labeling and a system to facilitate the hinge insertion. We also have optimized the sequence for post-processing (polishing, painting) and ink-jet decoration. We have achieved a remarkable quality of surface finishing in polyamide frames, while the finishing of metal surfaces was feasible but very expensive, so it was not used in the demonstration.

Final ink-jet decoration has revealed to show some restrictions when applied on highly curved surfaces, so its use has been restricted to side temple decoration.

In summary, the main innovative results in the flexible frame manufacturing are:

 Polyamide and Titanium frames can be produced by laser sintering for the first time. Laser-sintering processes and materials have been optimized.

 Surface polishing research was a big challenge, both for metal and polyamide frames. Metal polishing was demonstrated but at a very expensive cost, while polyamide polishing was possible at a, comparably, lower cost. Nevertheless the perceived quality of the personalized polyamide spectacles is perceived differently from French and Portuguese opticians and customers.

 Inkjet printing for decoration of temples shows limiting potential for curved surfaces, so previous spray coating was applied in the polyamide frames; nevertheless, the choose combination of spray coating and ink-jet decorations provides attractive designs.

The foreground generated has allowed EOS to identify a new kind of use for their laser sintering machines, and envisages commercializing a service related to support the RX Laboratories or companies willing to produce personalized spectacles. The company has made a complete exploitation plan of this foreground that is available in the PUDF.

WP6: Integration and operational research

Objective of this Work Package, conform the directives and topologies of the recommended value-chain blueprint(s), is to weave together all constituent processes, actors, information, materials, and equipment into one value-chain workflow that forms the base for the demonstrator test.

The popular paradigm of virtual factory, inspired by the European Technology Platform Manufuture, leads us also to research new models for integration, management, and control of the production value-chains. With respect to our planned advances of prior State-of-the-art we intended to deliver, a) a definition of standards and architectures that enable the exchange industry design data among B2B supply-chain players, and b) the necessary toolkits that help ophthalmic industry participants to adapt their ICT and Manufacturing infrastructure and systems in order to connect into the dynamic, scalable and reconfigurable value-chain networks.

There has been an intense collaboration from partners involved in the entire value chain to set-up and refine the Feature based model (FBM) of the automatic manufacture of personalized spectacles, needed in the frame and lens co-design process and also needed for the automatic calculation.
We have also created definitive system architecture for the master control and manufacturing systems that will manage and control the value chain. This web-control system was tested in the demonstrator tests and users expressed their preference for a more user-friendly environment. Any further evolution of the web control system will incorporate logistics and carriers, which were not included in this demonstrator.
In summary, the main innovative results in the integration and operation work-package are:

 Application of the FBM methodology of customised products related to personalized spectacles in an integrated environment of a dispersed and international supply chain.

 Intelligent supply chain management applied to the customised spectacles production

The foreground generated has allowed Ascamm, and the SME Plastia and K-Int to build an FBM model and a corresponding control platform that allows for an upgradable system for safe automatic calculation. The three companies have made a complete exploitation plan of this foreground that is available in the PUDF.

WP7: Demonstrator
As a proof of concept, a Demonstrator was built as the main task of this Work Package. During the previous months all the elements (HW, SW) necessary to implement and test the Demonstrator were defined, developed, tested and assembled. Per the technical scope of the project, they are grouped into a User Data Acquisition System, Automatic Design System, Lenses System, Frames System, an Integrator System for lenses and frames, and last, the required ICT system. Eventually, this Work Package aims to assemble and integrate manufacturing and user measurement equipment, predefined processes, trained workers and systems in order to test under real life conditions the assumptions about the feasibility of the recommended business model(s).

To this end, we tested a Demonstrator value-chain within a European transnational configuration. An important purpose of the demonstration is to gather information required to feed the Business Models evaluations after questionnaires answered by opticians and end-users after the personalized spectacle sale and wear tests. Consequently, projected benefits, short-comings, and sustainability of individual profit margins of each chain-participant, as predicted by the Business Modelling Work Package, were verified in this phase of the project

Two head scanners were built by IBV; one was installed at Optica Pita in Setúbal, Portugal and the other one at Tipheret in Annecy, France. Both opticians altogether provided 158 users that were scanned and subjected to the co-design process. Up to date, 82% of the users have received their personalized spectacles and tested them for a period of at least one week. The remaining spectacles are or course. Inputs from users show a general positive assessment, despite some of them consider that the frame aesthetic quality shall be improved, and that the personalization algorithms need further refinement.

In summary, the main innovative results related to the demonstrator are:

 158 different users have been scanned and, a personalized spectacle has been automatically calculated and processed according to their needs and preferences. This is an innovative breakthrough, because, up to date, there is no other automatic measuring and designing system to personalize spectacles.

 To date, 82% of the frames has been manufactured and delivered to the users, who have provided his mostly positive feedback.

 Though real delivery and manufacturing costs were not still competitive, the target manufacturing costs and delivery times have been identified.

The foreground generated has allowed the SMEs Tipheret and Pita to test in real conditions the feasibility of the concepts within Made4U. The three companies have made a complete exploitation plan of this foreground that is available in the PUDF.

Potential Impact:
Dissemination and exploitation of project aims to make broadly known to a number of target audiences the results achieved by the different research Work Packages, during the project life-cycle. All of the Consortium Partners contribute to this Work Package whereas UAMS as the Work Package leader assembles content and administers dissemination events and activities. UAMS will also establish a Dissemination and Exploitation Master Plan that will be regularly revisited and adapted.
In summary, the main activities done in relation with exploitation and dissemination are:

 Made4U had a considerable dissemination activity through the presence in several international conferences, press and web activity. A dissemination event was organized at the end of the project with considerable attendance success.

 The exploitation was prepared according to the teaching of Mr. Caocci in the ESS seminar and the Osterwalders Canvas method. It is an important part of the PUDFK, which contains the exploitation plans of the 13 partners. A possible joint exploitation of the scanner is envisaged between Indo and IBV, and a joint exploitation of the platform between Ascamm, Plastia and K-Int. Finally, the successful exploitation of the Maxima lenses is being made by Indo since several months ago which has cumulated more than 60.000 lenses sold.

 Important IP has been generated during the period; 3 patents have been filed that are related to products developed in WP3 that support the commercialization of the Maxima lenses.

Dissemination activities: We are present in the web via our site https://web.archive.org/web/20140209004655/http://www.made4u.info/ We have created and maintained the project website from February 2008 to mid July 2012. Over the four years we have had an estimated 35,000 page views and 2,500 unique visitors. These were quite reasonable traffic statistics for a website of this type.
The Project Information provides general information about the entire project, whereas the Consortium link shows all the partners with links to their respective websites. Innovation 101 is where we have published articles during the lifecycle of the project. The same articles were also fed to the Press for publication. News and events report a number of happenings that were considered relevant in the frame of this project and in the Downloads section we have provided the possibility to download project related files by the site visitors. The contact link provided the opportunity to visitors to exchange ideas with us in the project. The Search and RSS are standard website functions and the Login is reserved to few registered users and the Webmaster.
Additionally, we have published the following articles, documents and papers:

1. Innovative Business Modelling Techniques
2. Using 3D design techniques to create personalized frames
3. Made4U Personalization: A new shopping experience
4. Adapting Spectacle Frames to every face on earth
5. The Benefits of personalization
6. REDO: Spanish meeting of Optical Designers
7. Maxima Progressive Lenses by Indo (a Poster Chart)
8. Optomorphism (Trademarked by Tipheret)
9. Inlet for Prosumer.Net for the needs of the Aarhus Industrial Technologies Conference.

We have, additionally, prepared extra material for the events listed below:

The first seven articles were published in our website and sent out to the Press. Per request of Tipheret, the Optomorphism article, originally published as the rest, was removed from our Website for copyright infringement claims. Optical World has republished the Adapting Spectacle Frames to every face on earth article in September 2010 (shown hereunder) and a second in June 2012.

We have been present in 2 International Technology Exhibitions; 2010 and 2012, and in the Silmo fair in 2010 and 2011. In the following table we summarize all dissemination activities done during the period.

Exploitation activities: We have prepared an extense PUDF document that contains the main exploitation plans of the partners and its risk evaluation. The methodology that we have followed is a combination of the ESS seminar that we attended in Brussels combined with Osterwalders Canvas approach.
The exploitable results identified are listed in the table below:

For each and every exploitable result, each partner has produced an exploitation plan which describes the main components. It has also identified all interactions related to IPR as per the MULO matrix methodology.

IPR generated: Part of the foreground generated was protected with three international patents by Indo Lens. Below we list the application numbers and titles. The patents are not yet granted.

List of Websites:
https://web.archive.org/web/20140209004655/http://www.made4u.info/

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Permalink: https://cordis.europa.eu/project/id/212002/reporting