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Consumer Open Innovation and Open Manufacturing Interaction for Individual Garments

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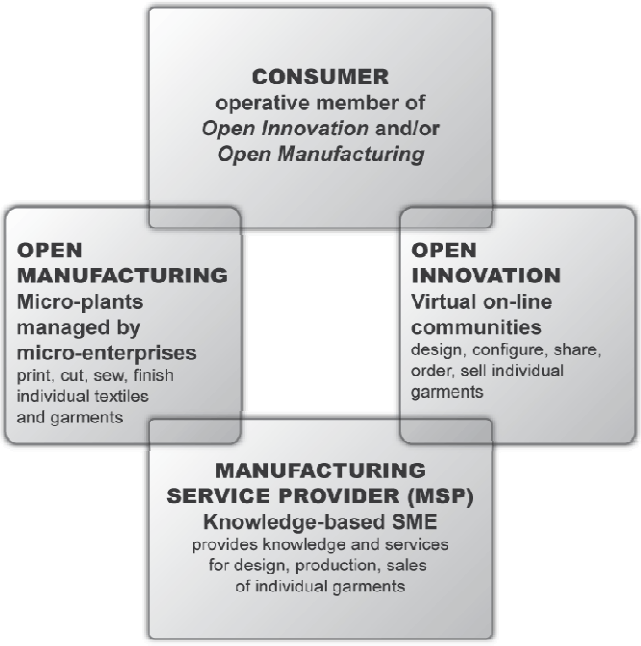
1 Final publishable summary report

1.1 Executive summary

The overall objective of OpenGarments "Consumer Open Innovation and Open Manufacturing Interaction for Individualized Garments" was a concept and related methods and tools for a new business model that enables SMEs for design-based consumer goods to offer new services and better products to the consumer.

The strategy was to apply *Open Innovation (OI)* principles and to create the *Open Manufacturing (OM)* concept for flexible manufacturing networking thus enabling the creation of individualized garments and accessories, by



- taking the capabilities, the knowledge, the creativity, and the willingness of consumers by means of web-based virtual communities of individuals,
- adapting and integrating (also) existing digital technologies for design and production of individualised garments, fabrics and accessories in a framework of *Open Innovation* and additionally of *Open Manufacturing*, and by
- turning this into a new organisational concept for SMEs using appropriate business models and tools for the *Manufacturing Service Provider* (MSP), which coordinates, supports and partly manages the Open Innovation consumer community and the Open Manufacturing network.

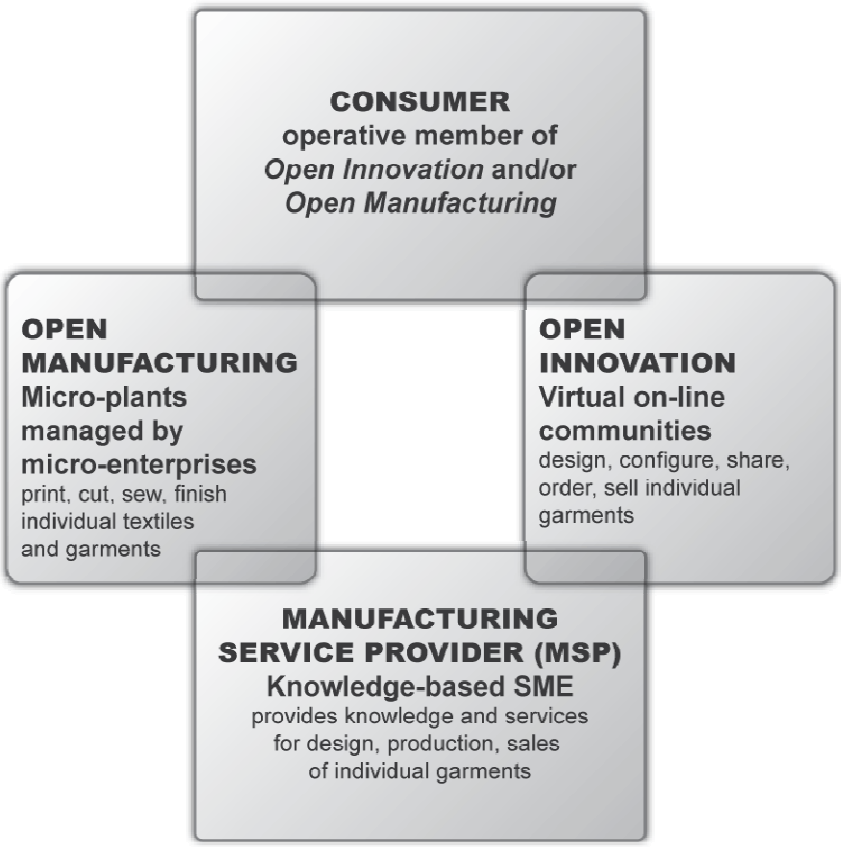
The related work for development, together with industry, and for testing in industry was structured into five work packages (WP), and led to a set of scientific and technological results, of which some of them will be commercially available in the very near future. As one main result, the OpenGarments platform with a on-line consumer community and on-line product configurators has been successfully implemented and approved. Further results relate to flexible provision of services for high-quality digital textile printing, to flexible creation of on-line configuration spaces including visualisation and made-to-measure for garments, and to design and Rapid Manufacturing of accessories. Also the OM networking of MicroPlants was demonstrated successfully.

Co-ordinated by DITF-MR OpenGarments was performed by 14 organisations of nine countries, of which CTX and Bivolino.com were the main industrial drivers, who were – as early adaptor – already applying basic functionalities. Altogether five research organisations, four technology providers and five industrial partners, of which eight partners were (like) SMEs, collaborated in this 3 years FP7 NMP research project.

1.2 Context and objectives

The overall objective of OpenGarments "Consumer Open Innovation and Open Manufacturing Interaction for Individualized Garments" was a concept and related methods and tools for a new business model that enables SMEs for design-based consumer goods to offer new services and better products to the consumer.

This model enables a new way of design, production and sales of consumer designed and configured garments, based on the provision of individualised services and products to customers and partners. This leads to new product designs, to a much more customer satisfaction, and to an improvement of the stability and competitiveness of SMEs. Applying this the European Textile and Clothing Industry will be able to create and provide individual garments with a very high degree of customisation in terms of fit, fashion and function at a comparable price in a short time.



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- turning this into a new organisational concept for SMEs using appropriate business models and tools for the *Manufacturing Service Provider* (MSP), which coordinates, supports and partly manages the Open Innovation consumer community and the Open Manufacturing network.

Open Innovation in general is the collaboration between enterprises and customers/consumers within the product/service innovation process, where all actors in the value chain contribute and share knowledge.

Open Manufacturing is a new concept for the production of customised physical goods, in this case of individualised garments and accessories. *OM* describes a flexible network of production units ranging in size from MicroEnterprises to SMEs. All production units are aligned to mass customisation and rapid manufacturing for fast and flexible fulfilment of small size orders. The coordination and support with vital services of all these small production units will be performed by the *Manufacturing Service Provider (MSP*), enabling the MicroEnterprises to concentrate to its core competences.

(1) The *Open Innovation* element is driven by virtual communities of consumers, which act as not only as customer, but also as developer/designer and operate also micro e-shops. Thus she/he will be enabled:

- to customise and to design individual garments regarding fit, style, and function in terms of size, shape and model, design, accessories, buttons, labels, colour, fabrics weave, patterns,
- to buy this garment (supported by order processing and monitoring),
- to spread, publish, share and sell these designs within and beyond the virtual community, in order to improve the designs or to create new ones and to extend the existing retail business or to create new business by selling these designs and the products.

The *Open Innovation* concept has to be seen in the context of "Social Commerce" and "Web2.0". The basic mechanism behind *Open Innovation* or open source production is that individuals are willing and motivated to contribute with their knowledge and capabilities to activities within virtual communities for free. Well known innovations and products are e.g. Wikipedia, or open source software like the Apache web server. Micro e-shopping is well-known through eBay.

The *Open Innovation* concept, together with relevant tools, was adapted for configurable high-quality garments and accessories, and extended with the possibilities to share ideas and designs, and to sell them. A common request is that the OI consumer community platform has to be simple to use, web-enabled, and for free, in particular related to a sophisticated and easy-to-use user human-computer interface. Therefore a software platform has been developed, integrating functionalities for social networking, on-line shopping and configuration of garments, fabrics and accessories, and sharing and selling of designs and configurations by the consumers. The initial on-line configurator of garments was provided by the partner Bivolino, which is a producer of customised shirts (in terms of size and configuration). The related modules had to be adapted for improved configuration, visualisation, sharing and selling of different garments types (blouses, leisure- and nightwear). This related also to functionalities for made-to-measure sizing of garments, and for on-line visualisation. Further modules, e.g. for fabrics to be printed with ink-jet technologies, and for accessories and trimmings to be created with Rapid Manufacturing technology, had to be integrated, all within a service oriented architecture (SOA).

Essential for achieving this objective was the successful creation of the on-line user community (social network), with different skills and capabilities, and the successful transformation/translation of the knowledge of such a virtual community into product and process knowledge.

This concept could only be successful if the customised good can be produced very quickly and at comparable prices. Therefore the new *Open Manufacturing* concept has been developed. The idea was to create MicroPlants of different types, which are managed by (new) MicroEnterprises or by (existing) SMEs, and to integrate them with further MicroEnterprises and SMEs into an *Open Manufacturing* network. In such MicroPlants the appropriate production technologies for single piece or small lots (such as digital fabric printing, finishing, cutting, sewing, rapid manufacturing, flex & flock printing, surface treatment, embroidery and garment finishing) are integrated within a seamless and flexible information flow structure. Thus the MicroEnterprises are enabled to provide the requested flexible and fast production capabilities/services for individualised textiles, garments and accessories.

Depending on the type of process and size of the required machines and relevant resources (water, steam, electricity), a MicroPlant should be realised as a dedicated plant (a special production site of an SME typical of very small size), as a plant-in-plant (parts of a production site dedicated for OM), as a dedicated small production site, or as a HomeLab (very small production facilities at home). Within Open Garments all four types of MicroPlants have been designed, prototypically implemented and tested, for different types of garments with different levels of creativity space. Also traditional services at different locations had to be integrated.

The third element is the new business model for a knowledge-based *Manufacturing Service Provider*. The business model follows the idea of Application Service Provider (ASP) and contains an architecture for the flow of product, service and information, the description of the various business actors and their potential benefits, and a model of the sources and revenue. Regarding the flow of product, service, information, and resources, the objective was to develop a (organisational and web-based ICT) framework where the services for *Open Innovation* and *Open Manufacturing* can be provided in an integrated, seamless way to the actors. Such services include a.o. access and/or functionalities to/for repositories of product models ("engineering database"), for product development and configuration (CAD), for production process preparation (CAM), and for business activities on the *Open Innovation* side and the *Open Manufacturing* side, e.g. for product configuration, for on-line shopping, for shop building, or for social network management. Services can be for free, or following the fermium Web 2.0 business model: some basic services for free and premium services at a very cheap price.

Summarising, targeted results of Open Garments were

- the adapted concept of *Open Innovation* for individualised garments, fabrics and accessories (design and configure, order, publish, share, assess, sell), together with related tools and a prototypical virtual communities,
- the concept of *Open Manufacturing* for flexible and quick manufacturing of individualised garments, fabrics and accessories, together with tools and prototypical MicroPlants in MicroEnterprises,
- adopted methods and technologies for digital fabric printing, on-line garment visualisation and made-to-measure configuration, and Rapid Manufacturing of accessories, and, finally

- a business model for the knowledge based *Manufacturing Service Provider* (MSP) .

The related work for development, together with industry, and for testing in industry was structured into five work packages (WP) around the three main areas *Open Innovation*, *Open Manufacturing* and *Manufacturing Service Provider* :

- WP3 “Open Innovation Consumer Community Concept, Instruments and Pilots” is for creativity, design and configuration,
- WP4 “Open Manufacturing Network Structure, Components and Implementation” and WP5 “Open Manufacturing Technology Integration within MicroPlants” are for the production, and
- WP 6 “Concept and Implementation of the Service Architecture and Integration of Services for the MSP” and WP7 “Synthesis of the MSP Business Model for a Knowledge-Based SME for Individual Garments and its Implementation”.

Complementary work packages focused to requirements collection, demonstration, dissemination and exploitation planning, and project management.

Co-ordinated by DITF-MR OpenGarments was performed by 14 organisations of nine countries, of which CTX and Bivolino.com are main industrial drivers, who were – as early adaptor – already applying basic functionalities. Altogether five research organisations, four technology providers and five industrial partners, of which eight partners were (like) SMEs, collaborated in this 3 years FP7 NMP research project.

1.3 Main S&T results

The following table provides an overview of the main scientific and technological results. In the following sections a description of the individual results is given. Further details can be found in the project deliverables and in the on-line resources.

No	Name	Nature	Main Partner
1.	Open Garments platform	Prototype	DITF, Bivolino, KHLim, CTX, TNO, Boondoggle, TXT, Androme
2.	Open Garments Manufacturing Service Provider (MSP) business model	Concept	DITF, Bivolino, CTX
3.	Open Garments Service oriented Architecture (SoA)	Prototype	TXT
4.	Modular garment configurator	Prototype	Bivolino
5.	Sizing of individualised garments	Method and prototype	Bivolino, TNO
6.	Fabric rendering and garment visualisation	Method and prototype	Bivolino, EDM
7.	MicroPlants "Bivolabs"	Concept and prototype	Bivolino
8.	Improved and integrated Rapid Manufacturing techniques	Method and prototype	TNO
9.	Improved Digital Textile Printing (DTP) integrated in a micro plant "digifabriX"	Concept, method and prototype	CTX, DITF
10.	Colour QPC	Prototype	Ergosoft
11.	OI Community building methodology	Method	KHLim

Table 1: Overview of S&T results

1.3.1 OpenGarments Platform

The OpenGarments platform is a web platform integrating and providing on-line community functionalities with on-line shopping, including product configuration and e-shops of consumers. One of the key features of this (electronic) platform is the ability to integrate different configurators (with different configuration spaces), operated by different MSPs, and to provide the necessary functionality for processing of configuration, ordering and payment of the different product types.

Figure 1 below shows a screen shot of the home page of the OpenGarments platform, with the possibility to access the different configurators with necessary background processing functionalities.

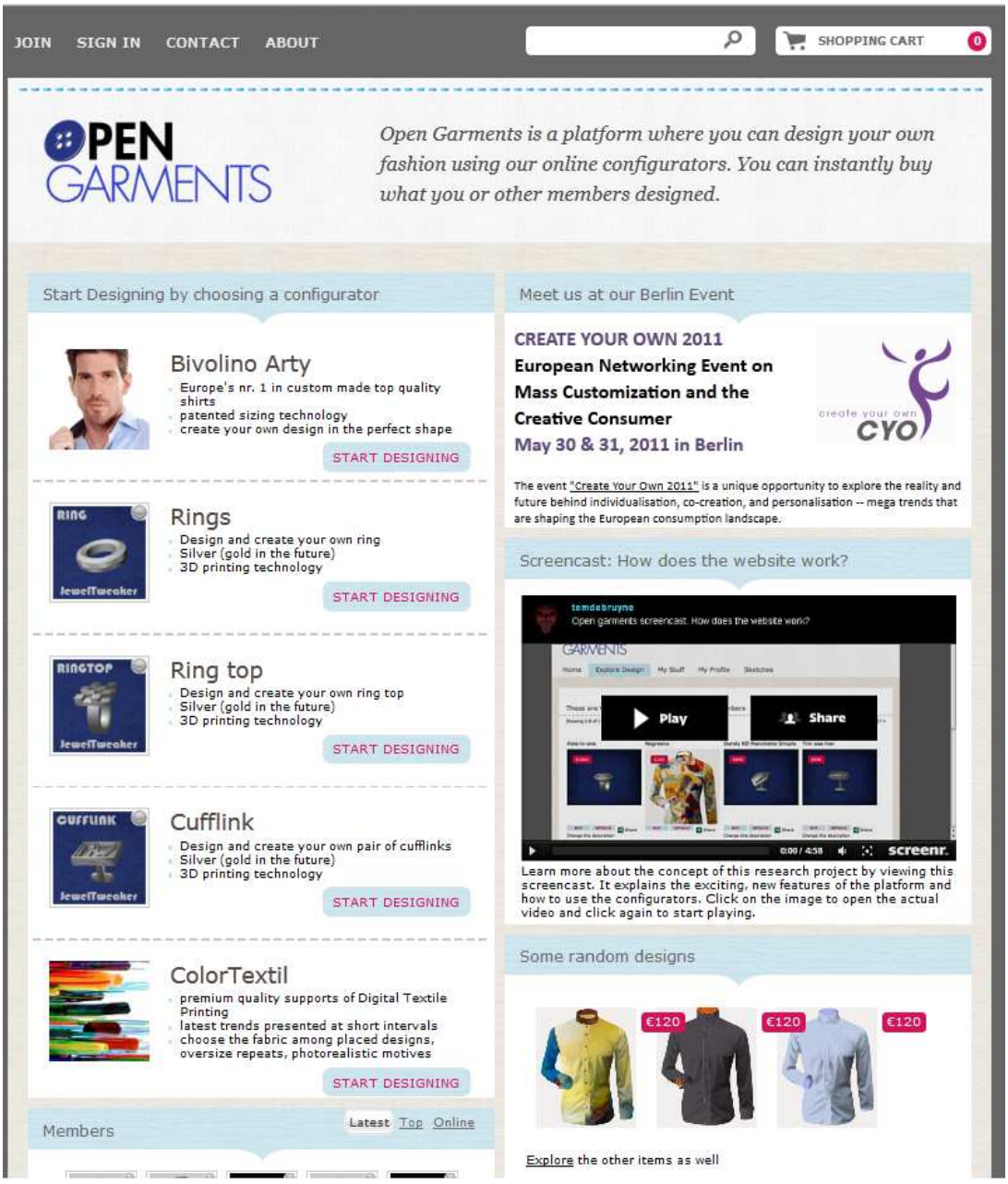

Figure 1 Open Garments platform screenshot (www.opengarments.com)

For the prototypical implementation and testing the open source software system Dolphin from Boonex (http://www.boonex.com/dolphin) has been used as the basic development environment. Particular attention has been put to the integration of the configurators from Bivolino and TNO, and the fabrics gallery of CTX, as services through the use of iframe technology.

As mentioned above, one of the main properties of the OpenGarments concept is the flexible management of complementary design based consumer goods, which can be highly configured and bought by the consumer in the framework of a social network, the OI online consumer community. The business partner of the consumer is the individual MSP, who is responsible for definition of the available configuration space, provision of the related on-line configuration services, and for product fulfilment.

The concept has been demonstrated through the integration and test of three configurators into the platform, each with different configuration spaces and configuration functionalities for garments, fabrics and accessories, provided by individual MSPs. Some detailed configuration options are described in the relevant chapters hereafter. Further functionalities relate to galleries containing uploaded and predesigned/preconfigured product items, and to shopping. The galleries provides several filtering options concerning date, price, name, rating, ..., and sort of product (which are in this prototypical implementation shirts, cufflinks, rings, ringtops and fabrics). Besides from sharing and ranking products created in the configurators also self-created sketches and designs can be shared and ranked.

The user can add preconfigured or self-configured items or into the shopping cart and pay via a payment service. The order with the configured item is processed automatically to the MSP. Reflecting the fact that different actors are part of the business (the design owner, the platform manager, the MSP), a related functionality for a flexible money flow, as defined in the business model described in the next chapter, has been developed and tested. The private section of the platform provides all functionalities related to user management and community communication and file sharing

Order processing, payment processing and the provision of order- and user information is done completely web based via this Open Garments Platform. All data are provided to predefined interfaces and there forwarded to the involved MSPs. The configuration and maintenance of this SoA-based community platform, also e.g. regarding the introduction of new MSP with new configurators, is managed by the platform manager and/or operator.

The prototype of this platform concept is one of main demonstration systems resulting from Open Garments. For the development and testing of the look&feel and the functionality a well-structured process was designed and performed, deeply involving users from the beginning, using the concept of focus groups. At the end hundreds of members of the community have been involved in the design and test of the platform. The platform together with the MSP business model is now subject of exploitation of the contributing partners DITF, Bivolino, KHLim, CTX, TNO, Boondoggle, TXT, and Androme.

1.3.2 OpenGarments Manufacturing Service Provider (MSP) business model

The Manufacturing Service Provider (MSP) is an organizational entity providing core competencies for product design, development and configuration, managing the product implementation and delivery, and interacting with the (end-)customer by means of social networking, preferably doing all on-line for customizable design-based wearable objects and accessories. The related business model considers the actors for the related services for the OI consumer community as well as for the OM network.

The services for the OI community contain such providing basic product models, "toolkits" for design, configuration and order of the product, for sharing and improvement of the design and for selling the product. The services for the MicroEnterprises, which are organised in flexible OM networks, include such for accounting, or for tracking and tracing. Further the MSP will maintain the configuration space with all related knowledge, manage the interface between the OI community and the OM network (in particular the translation of the product configuration information into production process instructions - CAD-CAM), and manage and/or co-ordinate the processes of production and logistics. The MSP will make use of a use the Service Oriented Architecture (SOA) as framework approach.

Major elements of the OpenGarments business, besides the order fulfilment, are:

- the on-line community;
- with contests enabling to concentrate the creative potential of the community on a desired topic, to attract partners that would not have participated at the Open Garments platform otherwise (even if it is a singular event) and to give the members the feeling that their work is appreciated;
- sub e-shop or sub-e-gallery that gives community members the possibility to bring in their creativeness and to be rewarded by earning royalties;
- affiliate programs for third parties, or premium memberships or functionalities;
- use of social media (e.g. Google, YouTube, Facebook); and
- potentially an own virtual currency

The main business actors are the OpenGarments platform operator, the Manufacturing Service Provider itself, the sub-E-Gallery owner, the customers and the community members. The Manufacturing Service Provider is responsible for:

- definition of the product range and the configuration space;
- iframing their services in form of configurators;
- processing orders provided by the Open Garments platform;
- logistics and shipment;
- management of customer enquiries, and warranty claims, and
- processing all order data provided by the Open Garments platform.

The sources of revenue are supposed to be mainly end-consumers aiming for personalized goods. Also there is the possibility to exploit contests, advertising and brokering designs submitted by members - which would be unique up to now and holds a great chance.

During the development two approaches have been deeply analysed: the centralized approach, where the MSP controls the entire supply chain from the (on-line) community to manufacturing and distribution, and the decentralized approach, where the MSP does not control the product range on the Platform. In order to be flexible, e.g. regarding the extension of the range of products (wearable, configurable products mainly made of textiles and leather; such as T-shirts, suits, blouses, boxer shorts, also footwear, and accessories like bags, backpacks, belts, ties et cetera), it was decided to follow the decentralised approach.

A set of diagrams describing the flow of information, products and money has been created. Figure 2 below shows an example.

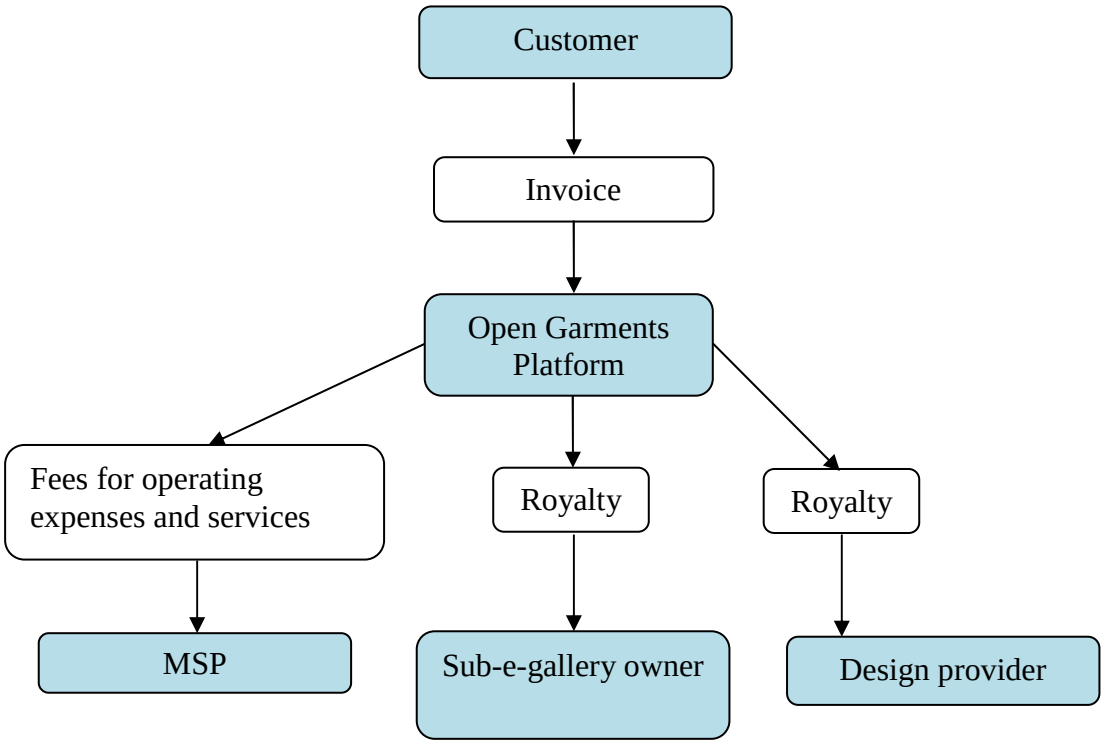

Figure 2: Exemplary description of payment flow case 2

For the implementation of such a complex business model and the underlying technical software platform, a phase model with three phases has been developed. Basic idea is to establish a solid basis with basic and necessary functions and to extend this step by step.

The business model has been developed and tested using the Open Platform and the consortium members providing the goods (Bivolino for garments, TNO for accessories and CTX for fabrics), and the test community. The feasibility has been proven, and during the ongoing exploitation this business model will be extended into a business plan.

More details about the business model can be found in the deliverable D7.1 "Open Garments MSP Business Model".

1.3.3 OpenGarments Service oriented Architecture (SoA)

Another major result of OpenGarments is the Service Oriented Architecture (SOA) providing the (mainly) ICT environment for the functionalities of and around the MSP, thus enabling the (organisational) service orientation and the necessary operations in the concerned on-line business.

The SOA is the backbone and the interface between all involved parties and enables the functional integration of all services. Thus it is, as a consequence, the integrator of the de-centralized Open Manufacturing approach, the Open Innovation consumer community, and the Manufacturing Service Provider (MSP) as e-commerce partner and provider of configurable products.

The starting point of the SOA is the Enterprise Service Bus (ESB), which is responsible for:

- integration of services and functionalities;
- conversion of messages from service to service; and for
- orchestration of services.

The ESB in OpenGarments has been realised with the OpenESB environment. OpenESB is open source, well documented, and it is integrated with a robust and well established development environment. OpenESB comes in bundle with Netbeans development environment and Glassfish server. All the three components are developed to work together, and include a graphical tool that allows developers to easily build the orchestration processes for integration of services. Work included the configuration of the ESB and the building of the orchestration logic that drives the behaviour of the system.

The orchestration processes are built in BPEL (Business Processes Execution Language). BPEL is an XML language specifically designed to allow the definition of processes, to define how the services registered in the bus interact with each other and how they exchange messages. With the graphical plug-in the design of the BPEL processes for orchestration of services and the message exchange management is very easy.

In the course of the Open Garment project the prototype has been implemented and tested with a subset of 20 identified and described services (as presented in deliverable D6.3 "Services and Interfaces for/to Open Innovation, Open Manufacturing and Open Garment Production Technologies"). It was also the starting point for the Open Garments platform as described in section 1.3.1. In particular the configurators from Bivolino and TNO, and the fabrics gallery of CTX have been incorporated as services through the uses of iframe technology.

The results have led to the implementation and spreading of the idea of service orientation in manufacturing. It became clear that the technical service orientation is one necessary and important step. The means and know-how is available, indeed, the successful application in (garment) industry still requests a lot of effort, mainly related to interoperation and harmonisation of data formats and content.

Still challenging is the change of enterprises and of entrepreneurs from traditional product orientation (or process orientation) towards a service orientation - products enhanced or embedded with/in services, or (manufacturing) processes offered as services.

Typically, more IT-oriented (or based) enterprises, in particular SMEs, are already a step ahead compared with industries dealing (mainly) with tangible products and resources. But the future will clearly go for servitization, and the Open Garments SOA provides important findings for this change.

1.3.4 Modular garment configurator

One of the key features of OpenGarments is the configurability of wearable products (by the consumer). Therefore an appropriate configuration space has to be defined and described, and it has to be provided by appropriate (on-line) configurators, and it has to be flexible. This means that the range of configuration options, e.g. garment size and style, fabrics material and patterns, contrast or labels, etc., has to be adaptable to many different target applications (regarding market, time, location, fashion, ...).

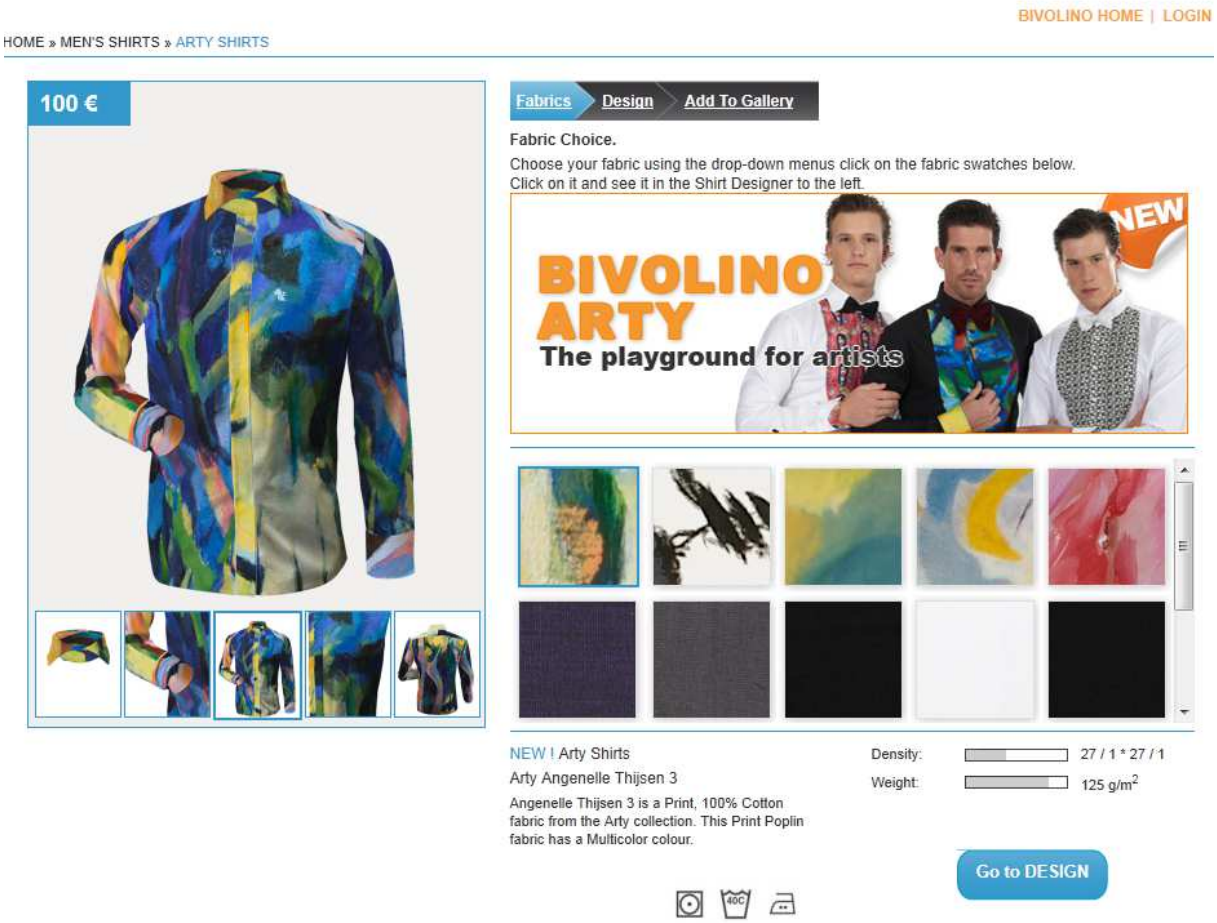

Figure 3: Bivolino Arty shirt configurator

Therefore a modular garment on-line configurator has been developed and tested. As already stated the flexibility and modularity of the developed configurators is significant. The development and testing was guided by Bivolino within several use cases. In every use case there are different configuration options, as well as a different graphic interface and an adapted service architecture concerning shopping basket, invoice processing and processing of the necessary information and feeding the different interfaces.

The garment configurator can be used as a service and integrated into websites using the iframe technology. Starting point was the existing configuration functionality provided by Bivoliono, which has been extended with functions for the definition of configuration space, with interoperability functions, and with the integration of the results for user data capture and sizing of garments (see next chapter). The configurator was tested within a selected configuration space "Arty" for shirts with fabric pattern created by artists (see figure 3 above). The garment configurator will be exploited by Bivolino.

1.3.5 User data capture and sizing of individualised garments

The main innovation is to have a low cost and easy to use system that will allow to automatically characterize the morphology of human body via Internet and to translate this morphology automatically into sizes for a made-to-measure garment, together with the related production instructions. Focus was put to blouses for women.

Selected female persons from Belgium and the UK were measured accurately and fitted blouses. It appeared that age, height, weight and chest dimensions were the best parameters to predict blouse size. The bra size is the easiest way to assess bust dimensions, but unfortunately many females wear the wrong bra size. It also appeared that subjective assessment of the waist and hip shape and of arm length was well related to the measured dimensions. The derived formulae are incorporated in a spreadsheet (see figure 4 below) that was made for the UK and European mainland in which the following parameters were used as input: age, height, weight, bra-size or (under)bust circumference and subjective assessment of the waist and hip shape and arm length.

A connection between the data input (front-end sizes input) - CAD (patterns) - CAM (cut files) has been established. The Bill of Labour and Bill of Material are generated semi-automatically in the language of the production plant, this information can be emailed, or set on FTP. Main Customer will be MSPs and relevant networks. It is a product adaptable to customer’s needs. They could use open sources for best fit adapted to their requirements and applications.

The developed methodology can be considered as a first step in the challenge to translate the enormous variability in body dimensions between subjects in individual made to measure garments. It is necessary to track the internet sales and to optimize the process by tracking consumer satisfaction. It is foreseen that in the near future garment sales over the internet will increase percent wise and the deliverable may help in making customers more satisfied.

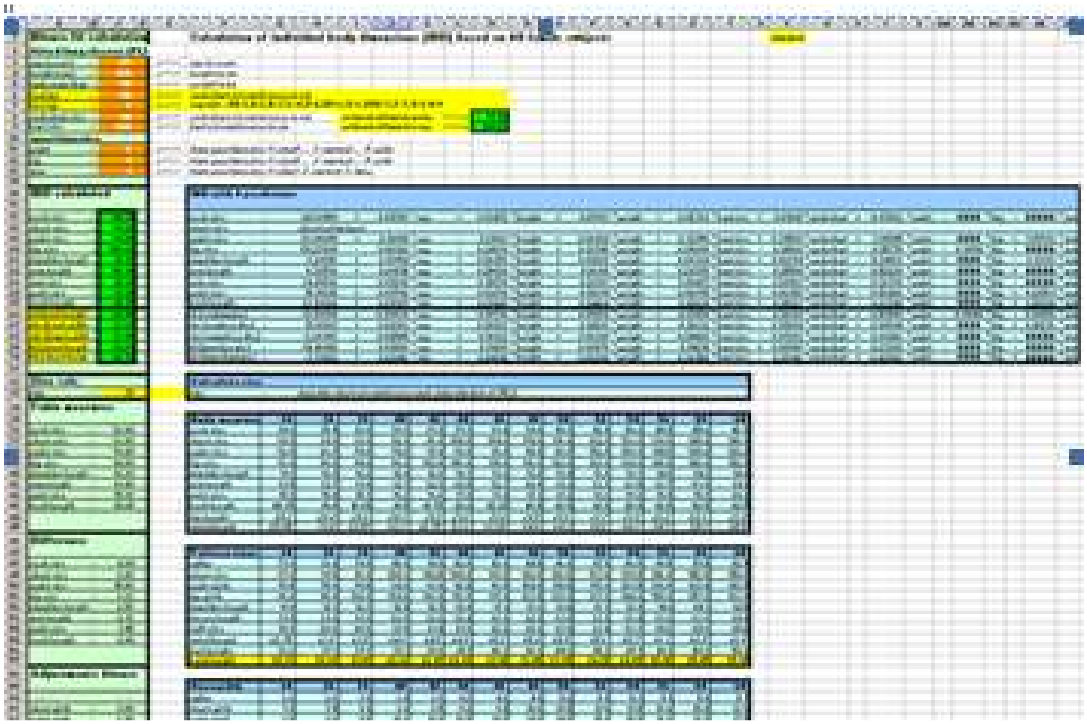

Figure 4: Outline of the formulae spreadsheet

The result has lead to a web application (see figure 5 in which self-reported information of the customer leads to individual sizing of patterns of ladies blouses. The description of the method and part of the results are published in the International Journal of Product Development so that other companies can learn from it. This seems in particular useful for the European continent to boost garment sales over the internet.

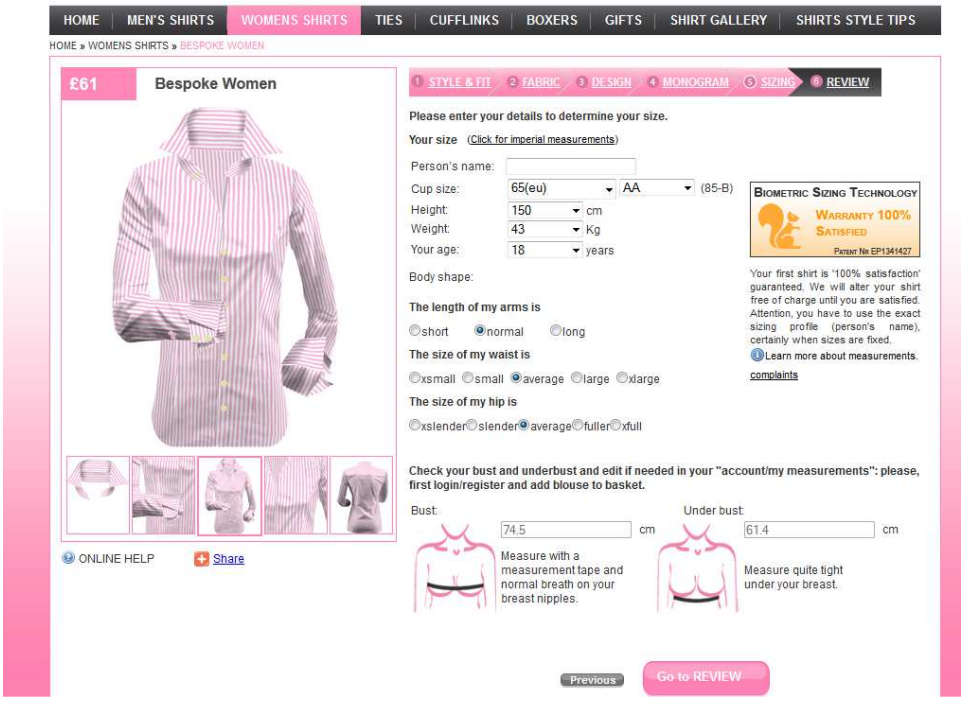

Figure 5: Screenshot of blouse configurator

1.3.6 Rendering: Visual 3D individualised garment design with co-design assistance

The objective was to create a method and a tool that enables a visualisation of pre-selected fabric (patterns) on garments during on-line configuration.

Before new patterns can be imposed onto virtual pieces of garment, models of the garments need to be acquired. Related to the model acquisition, a 2D image-based feature tracking and 3D structured light scanning method was followed. This technique uses a straightforward setup, merely consisting of a static photo camera on a tripod, surrounded by studio lighting. The features to be tracked in this case are coloured dots.

A special colour-coded pattern was designed, that consists of these dots, built in such a way that an analysis of the dots can tell how the piece of garment has been deformed. This pattern has been printed on fabrics, and with this fabrics a shirt of the target garment model has been produced (see figure 6 below).

Figure 6: Shirt with colour pattern

When analysing the photograph of the shirt shown in Figure 6, for every visible dot the methods identify its colour and the colour of its neighbouring dots. From this information, the location of the dot in the pattern can be found. Doing this for every dot, the deformation of the pattern on the shirt can be calculated and stored. Then a virtual representation of the shirt is created. The next step is the mapping of a (new) fabric texture to the garment

model. When placing any other texture pattern on the virtual shirt, it will be deformed in exactly the same way as the original pattern has been deformed by the shirt. This way the pattern follows the orientation and the creases of the shirt in a visually realistic manner.

A tool was designed for analyzing pictures of colour-coded garments and for rendering new virtual garments from that input. This tool reads its information from a Configuration file, including some useful parameters, allowing users to indicate which garments need to be rendered. A second tool, namely the Dot Adjustment Tool, has the purpose of aiding the user making adjustments to the analyzed dot information to improve the final rendering. This application currently has a steep learning curve, but has proven to be very useful by programmers. The process of converting this tool into a more accessible and user-friendly application would require a new approach to writing the code, keeping time optimisation and user interaction guidelines in mind. This is currently considered as an option for future work or for a possible follow-up project.

Both tools were used to obtain a massive amount of virtual garments, which will be used by the Bivolino.com website and the OpenGarments platform created by KHLim.

1.3.7 MicroPlants "Bivolabs"

Here a prototypical network of MicroPlants (called ‘Bivolab’) for digital fabric printing, finishing, cutting and sewing was established partly from scratch. The technologies for Open Accessories and Made-to-Measure were integrated into these MicroPlants. Various options for printing technologies (e.g. thermal transfer printing, inkjet printing), finishing (pre- and post-treatment of the printed fabric) and individual garment printing and decoration are offered. The various production technologies have been communicated to the employees spreading the knowledge necessary to work with the customised rapid manufacturing and made-to-measure technologies for Open Manufacturing.

The following MicroPlants have been established:

- Bivolab1: Photo’s testing on cuffs and collars
- Bivolab2: PES printing
- Bivolab3: Homelab manufacturing (sewing) of made-to-measure blouses
- Bivolab4: Platico CAM ink-jet printing, single-ply cutting and sewing

For all micro plant models of the processes related to order fulfilment including the production have been developed, using an integrative modelling language "SmartNetsModelling" (by DITF). Figure 7 below shows the example of the production processes for Bivolab1.

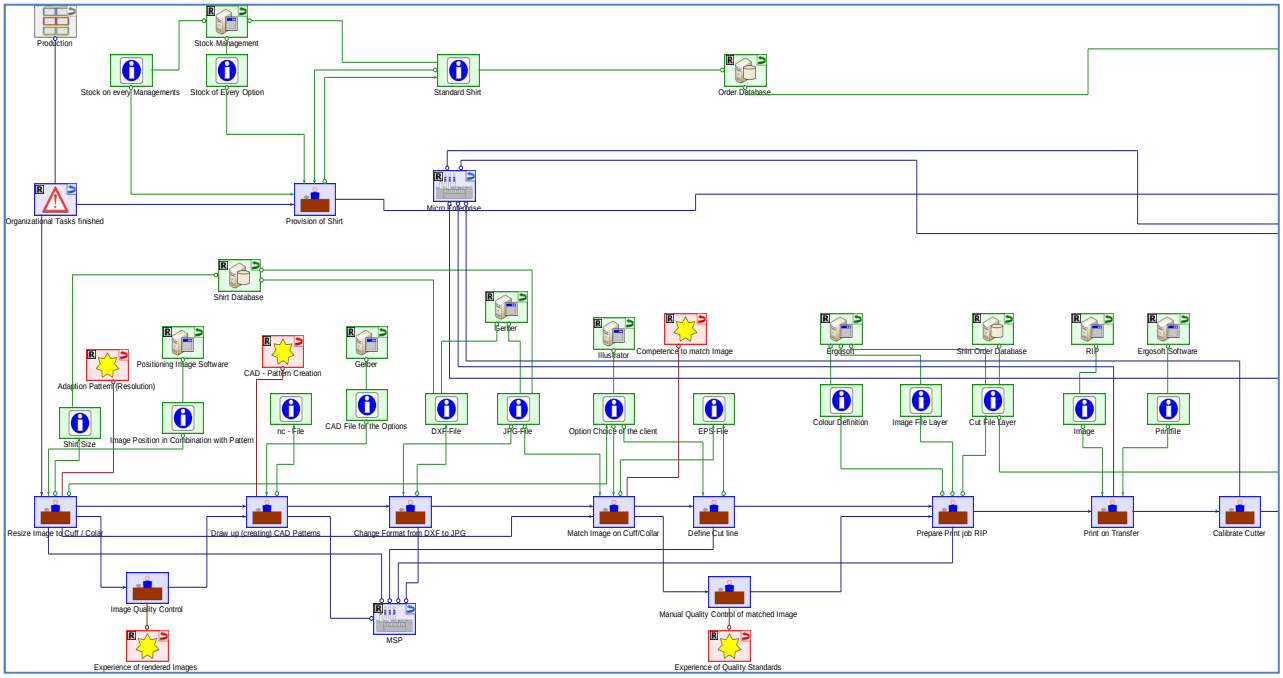

Figure 7: Part of Bivolab1 manufacturing process model

Concerning the single-ply cutting in Bivolab4, the challenges were issues about ‘placed design’ and the constraints of ‘straight forward processing’.

The following Figure 8 shows an allover painting from 1m x 2m. The cut lines of the Made-to-Measure CAD file have to match the direction of the frog in order to be nicely visible in the middle of the shirt. Patternmakers resolved the challenge of the matching the cutlines for the single-ply cutters to follow with the direction of the prints. It combines on-demand printing with the Made-to-Measure pattern single piece manufacturing:

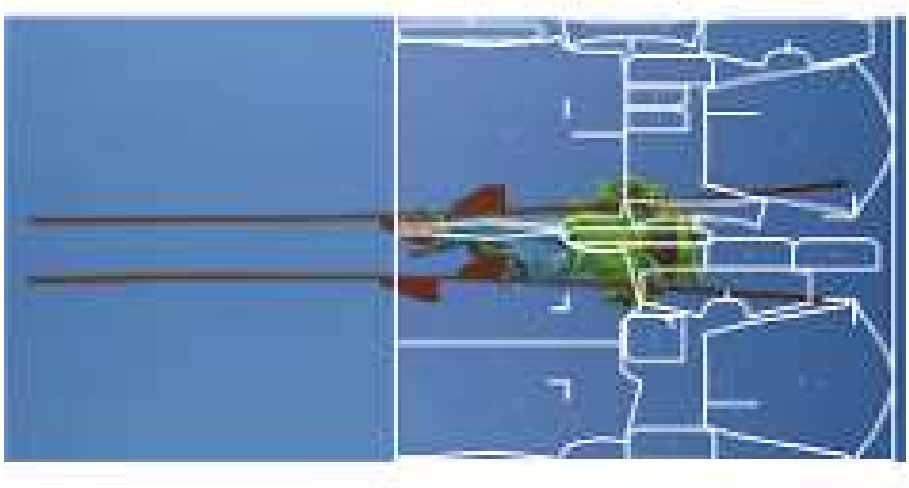

Figure 8: Cut lines of made-to-measure CAD file

1.3.8 Improved and integrated Rapid Manufacturing techniques

The JewelTweaker provides an on-line CAD functionality for design and development of cufflinks, buttons, rings and similar consumer objects to be produced involving Rapid Manufacturing techniques. It is a web-based creator to design accessories to garments. The creator is plugged into the Open Garments platform and surpasses all existing web based 3D design tools so far. The output of the configurator is directly suitable as input for an MSP in order to realise particular jewelry: cufflink, ring or ring top.

Figure 9: JewelTweaker portfolio

A particular consumer functionality in the JewelTweaker is the use of augmented reality: a live webcam image modified with a computer generated image of the cufflink being designed. In Figure 10 on the left, the original image of the webcam shows a cuff with a marker on the location of the cufflink. The right part shows the augmented image, where the marker has been replaced by the 3D view of the designed cufflink.

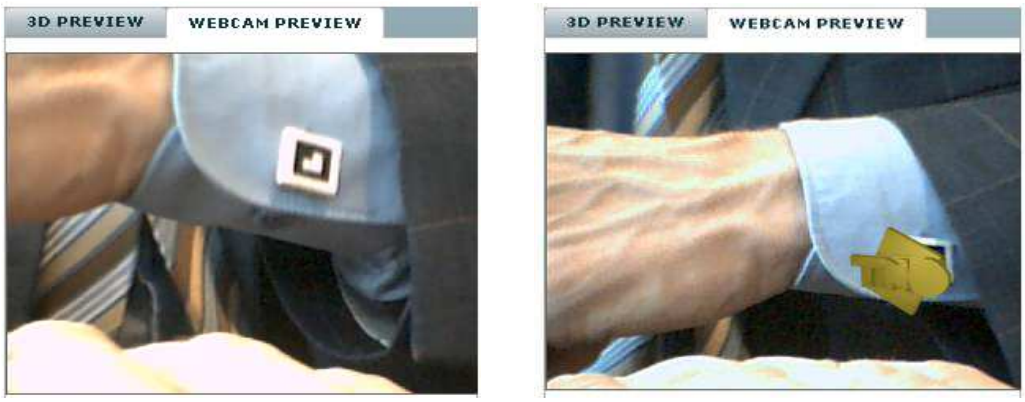

Figure 10: Augmented reality

The output of the configurator is directly suitable as input for the MSP to materialise the jewellery. A big set of rings and cufflinks has been designed with the JewelTweaker and realised with a number of RM processes with different materials, including nylon, acrylate, aluminium and titanium, stainless steel, and also silver and gold.

For the later, the use of RM is not new in the world of conventional goldsmiths. Printing a model in wax and making a mould from this wax model is a well known process. E.g. Envisiontec and Solidscape offer machines suitable for wax printing. The wax model is embedded in gypsum and, when hardened, is molten out from the gypsum. Then, silver or gold is cast into this mould. After finishing and polishing, a perfect jewel is available.

The prototypes of software and products have proven their feasibility. Next steps will relate to the improvement of the user interface of the JewelTweaker, and also to the range of materials. First intended customers are a jewelsmiths, then as second category 3D print service providers and as third category customers are all, who wants to extend the concept towards other applications where 3D design has added value to customise products.

1.3.9 Improved Digital Textile Printing (DTP) integrated in a micro plant "digifabriX"

In order to become very flexible with fabric provision for individualised garments on demand, it is necessary that low quantities (e.g. 1 m) of high quality of fabrics for the consumer-configured shirt can be provided in a short time and reasonable costs. The approach was to use Digital Textile Printing, prepared for small quantities, in the framework of a networking micro plant.

A pilot DTP micro plant "digifabriX" was set-up in Berlin by CTX with support of DITF and Ergosoft. It integrates all processes and technologies (e.g. printer, washing machine, fabric provision,...) for such on demand printing service for customers. The target groups are professionals for prototyping, designers, or garment producers requesting small production lots.

Figure 11: Micro plant "digifabriX" (premises Berlin)

The micro plant is embedded in an Open Manufacturing printing network and shows

- how to produce items for the Open Garments community based on an Add On System taking technical limitations into account;
- the challenge and limitations of technical development processes cutting and sewing for garments;
- the technical aspects of digital textile printing, fixation and washing in a micro plant for digital textile printing;
- color management procedures and management methods, focused on methods for quality management applied to micro plant for digital textile printing; and
- production services for the community – with the focus on professionals – here students from design universities.

It turned out that the following key tasks are important in order to run the micro-plant as a part of the Open Manufacturing network:

- setup a digital textile printing environment and factor different substrates with different ink-setups, after treatment, packaging and shipment procedures in.
- coordinate internal workflow / on demand procedures including CMM procedures.
- purchasing and inventory control for pretreated fabrics.

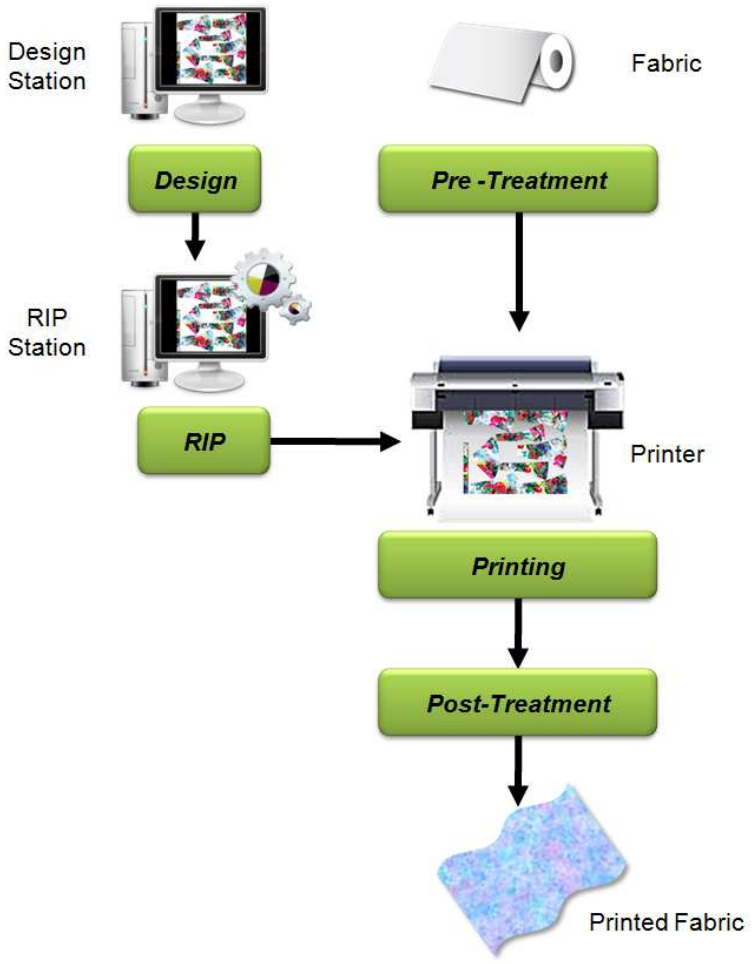

Figure 12: The digital textile production workflow

The implemented digital textile production workflow, shown in Figure 12, includes the following steps:

- design file creation,
- layout and RIPping of design file,
- pre-treatment of fabric,
- printing of fabric, and
- post-treatment of fabric.

In order ensure a high and reliable quality of the printed fabric, a Quality Management process was developed, which defines, tracks and measures the color and image process variations in each production step. If higher than expected variations occurs in a production step, then additional work can be done to perform a root cause analysis and determine the issue(s) impacting color and image quality.

Whenever possible, quality management is best performed before print production begins. This can include things such as:

- pre-inspection of fabric coatings,
- following style guides for creating design files for printing,
- developing job tickets for specifying color profile and printing requirements for a design file,
- conducting daily or per shift color and image quality checks on printers, and
- monitoring the post-treatment wash, steam, and fixation parameters.

In particular the Digital Textile Test Suite (DTTS) was designed for assessing the color and image quality of output generated from Digital Textile printing systems. The test suite contains image files for both qualitative (visual) and quantitative evaluations. Specific assessment parameters in the DTTS include:

- color uniformity and accuracy,
- dimensional accuracy,
- ink/substrate bleed characteristics,
- material shrinkage and dimensional accuracy,
- assessment of ghosting artifacts, and
- line quality.

The micro plant was used for several demonstration activities. The basic feasibility has been proven, and the next steps are to improve and to extend the technical infrastructure and the business model.

1.3.10 ColourQPC

Ergosoft ColorQPC™ is a color quality process control solution for monitoring and certifying color results from a digital textile printing.

The following aspects are covered:

- determine whether a color profile produces accuracy color results;
- assess potential color differences with ink and media lot changes or printer maintenance;
- ensure critical spot colors in a production job are printed correctly; and
- certify that a printer, ink and media combination print output to a specific printing standard.

The module ColorQPC™ Measure prints and measures a definable set of colors from a swatch book or named color recipe and checks whether the printed colors fall within preset color tolerances. Customizable color difference statistics and summary results are reported on screen and as a HTML document for easy assessment of the results.

The module ColorQPC™ Analysis provides quality departments and production managers with an overall summary of color process control information from a given printer. ColorQPC™ Analysis computes historical color results either for all print production jobs or for jobs run over a specific time frame. This makes it possible to monitor color quality trends and certify the color results from a given digital printing system.

Both ColorQPC modules include options to conduct color process control comparisons to an expected set of color values or to results from previous production runs. The color coded HTML reports also make it easy to identify which colors or production jobs passed pr exceeded the required color tolerances.

ColorQPC™ will be included in ErgoSoft V14PosterPrintPro, Premium and all TexPrint Editions and will work together with all color measurement devices supported by Ergosoft's V14.

1.3.11 Open Innovation community methodology

In order to support the community building, a consultancy based methodology model with which SME management teams can be guided in their challenge to think off, set-up, develop and publish a live online community environment has been developed. The service also includes the guidance to and selection of preferred suppliers such as graphic design agencies and interactive development teams. The SME will be supported in the overall process of community creation.

This includes e.g. the creation of a community that will be launched in different phases, whereas the first waves are part of a controlled wave, and starting from wave 3, it can be spoken of a public launch:

- Wave 0 – Controlled tests by small user groups: In order to gain insights in the usability issues at stake and identify the major flaws in the community, multiple tests with small user groups were organised.

Figure 13: Pictures of testing the interaction design

- Wave 1 – Power user access: In this first wave, the power users of end users and designers (20 to 30 users) were asked to test the platform and report any errors or difficulties.
- Wave 2 – Power users can invite: The second wave builds further upon the first waves and gives the Power users the possibility to invite people from their personal network (friends, relatives, acquaintances) to become part of the Open Garments community.
- Wave 3 – Project partners can invite: All project partners will receive e.g. a package of 250 exclusively designed business cards. In this way, a snowball effect can easily be created.
- Wave 4 – Members can invite: All community members (users that are already part of the platform) are asked to invite other potential users from their personal network. In this way, the community will expand and grow organically.
- Wave 5 – Series of events: During a series of events, the community will be demonstrated and people have the opportunity to register and become a member.

This process has been successfully applied for the creation of the Open Garments community testing the Open Garments platform.

1.4 Potential impact, main dissemination activities, and exploitation of results

1.4.1 Potential impact

Regarding the impact of the Open Garments project there are three main fields which are industry, society and as individual part of the society the customers.

European industry is influenced with regard to new business model(s), new (on-line) market approaches, design and development sources, flexibilisation for production of personalised design-based products, methods for high quality manufacturing in networks and structures for organisation and operation of small scale production systems "micro-plants". The main "pillars" are service orientation, consumer interaction& integration, organisational and social networking, online orientation, garment sizing methodologies and digital production (in terms of digital textile printing and rapid manufacturing.

The customers in this case is mainly the end-consumer, which will play different roles in this context. Besides the classical role as end-consumer he/she will be empowered also to act as designer and/or configurator of fabrics, accessories and garments, and as sales person, making business with the designs/configurations and the product. Besides this more tangible impact, also the consumer satisfaction will be increased by the possibility of the industry to provide individualised wearable products tailored to the needs and preferences of the consumers, at a reasonable price and time.

The overall concept of Open Garments also answers to the shift to on-line activities in society, which are today almost even standard for the young generation. It combines in a smart way the provision of traditional products of daily use with opportunities of the digital world as a, answer to the increasing demand of individualisation and personalisation, not only for physical objects, but also for activities and actions of citizens in society.

The concept of social (on-line) communities, together with the ability of creating and producing small series or lot-size-1, made-to-measure products offers the possibility to address small markets. Dedicated (niche) groups can be served much more effectively, as their needs and wishes can be identified and answered using a direct communication. This will have a positive impact for the inclusion of (social) groups, such as e.g. disabled people.

Impact to Industry

As already mentioned, European SMEs of the textile and clothing industry and related sectors will benefit from the Open Garment results addressing the creation and distribution of design-based, individualised consumer goods, prototyped with garments, textiles and jewellery &accessories. This relates to new business model(s), new (on-line) market approaches, design and development sources, flexibilisation for production of personalised design-based products, methods for high quality manufacturing in networks and structures for organisation and operation of small scale production systems. The driving concepts are service orientation, personalisation, consumer interaction & integration, organisational and social networking, online orientation, and digital production.

On-line business, in particular for (design-based) consumer goods, is almost indispensable today. Thus it is no longer a question of benefit, but a question of what do I loose if I do not apply it. The results of OpenGarments show to industry how on-line business, in particular for personalised wearable goods, can be implemented and operated. The MSP business model provides a guideline and prototypical structures and means for organisations changing or extending their business strategy with on-line means. Basically in can be applied by many SME, not only of the TCI sector. E.g. the TCI in Europe consists of more than 100 000 companies, and at least 10% have relationship with retail and other organisations linked to the consumer, or to organisations of other sectors which are using textiles as materials for their products. Regarding the business-to-consumer (B2C) channel the prototypes have shown that a successful business is possible, but requests a lot of effort for designing and operating a comprehensive, reliable and efficient business.

Personalisation and individualisation of design-based products is clearly a benefit for the consumer. Impact to industry when creating and offering such products and performing the related processes can be very high in terms of additional sales and market recognition. This refers in particular to the growing importance of "niche" groups (and niche markets). With on-line business the limits of geographical distances can be overcome - people having individual needs and preferences for their clothes and other design-oriented/design based objects, like shoes or chairs (e.g. people with health problems need wearable objects with special shapes, materials, or handling possibilities) can be reached easily with e-commerce. A critical mass of customers, and resulting orders, is most likely, and a economically successful business offering small series (or MTM) products on demand will become possible. Open Garments developed sophisticated concept and tools, prepared for industry, offering new, integrative ways of addressing small markets. Relevant results are e.g. the customisable garment configurator and related order processing means. The "long tail" effect is (better) exploitable for the European SMEs.

On-line business, together with social media, also opens a new way of interacting the consumer as customers. Advertising and marketing can make use of these means, but need a clear and detailed concept, and a reliable and consequent implementation and operation. The direct link with the customer can increase customer loyalty, but can also increase effort for this. In Open Garments the idea was to use social networking means, which should work by "itself" without big effort for managing the on-line community. The results proved the technical feasibility, but showed also that the effort for creating and operating a consumer community is much higher than expected.

Industry can benefit from the ideas and creativity of the crowd. Crowd sourcing, as one occurrence of Open Innovation, means to use the willingness and (intrinsic) motivation of like-minded people, to create or to improve (things). Successful Open Garments examples "Arty Design" for fabrics used in shirts, or the garment&fabric designs created during the contests. The means, such as e.g. gallery and ranking, or the concept of contests, are basically available, and the potential has been identified, but the successful exploitation and application of this concept still needs further development. Even if there are a lot of sources of ideas, the design (and also the development) can only be done by professional designers. The existing process of initiating or identifying ideas, extracting, processing and

finalising new designs has to be further elaborated, and implemented as full business processes in industry. The Open Garments results are a first step, in order exploit this source of creativity.

At the same time, very important and necessary, is the improved flexibility regarding configuration of product and processes, enabling not only to answer quickly to market request and trends, but also to drive market needs and wishes by appropriate, maybe localised or context-sensitive product (configuration) portfolios. The Open Garments results show how such flexibilisation can be implemented, by e.g. involving service orientation, manufacturing networking or by high-quality small series production technologies for the targeted products. Enabling such mass customisation clearly strengthens the European TCI industry, enabling them to pro-actively act regarding current and future challenges of globalised business and competition.

Next, service orientation or even service-based business is a clear trend for the future. Examples are to offer and sell mobility instead of a car, or operating hours of a jet engine by the manufacturer to the airline, instead the engine itself. Starting point is the service-oriented (ICT) architecture and related web-services, which is in use by a lot of ICT SMEs, and which is starting to be broadened in the manufacturing industry. At the same time the TCI is operating the general service concept already since many decades.

Combining both facts together - (ICT based) SoA and traditional service orientation (e.g. for garment making, named CMT - Cut-Make-Trim) - will enable the TCI industry to apply the service concept in a comprehensive, reliable and future-oriented way. The related ICT orientation, using also common standards (e.g. USDL for web-services) will also simplify interoperations with other industry sectors. The Open Garments SoA with the platform and services, which showed the applicability of this concept, the manufacturing networking structures and the MSP business model are important contributions towards this servitization. New service-product concepts, and new manufacturing service business will be enabled. The team will exploit the related results, also by bringing them to market, and thus improving the situation of the TCI regarding future challenges for new market approaches and requirements. This refers to all business activities: design and development, production and planning, logistics, sales and distribution, and related systems (e.g. ERP, SCM). Also servitization research is ongoing, in order to put the concept of manufacturing service to a broad and well-founded basis, e.g. within the research project "MSEE - Manufacturing Service Ecosystems" (EC FoF-ICT IP No. 284860, www.msee-ip.eu).

Networking of (industrial) organisations is one of the key concepts for becoming more flexible when addressing niche markets (on-line) and producing small series on demand. Open Manufacturing, as researched in the project, provides a structural base, and will be applicable by related means, for e.g. high quality fabric printing. In particular the focus to networking of small production units, called micro-plants (also referred to as mini factories), will have impact to manufacturing industry. Even if the TCI is performing networking and outsourcing since centuries, today globalised and ICT-supported business requests a significant change of the use of networking, starting of course with the (Information and communication) technical means. Potential benefits are basically obvious, but also

disadvantages and risks. Focusing to small, localised production units (as e.g. the DTP micro-plant digifabriX) and their technical and organisation interoperation, it can be expected that this concept will bring significant benefit to industry (and consumer) by reducing logistic effort and time, applying and exploiting local knowledge and competence, increasing quality and reliability of products and processes, and also raising market proximity.

Relevant results of OpenGarments will be exploited by the industry partners, but still request a lot of development, and - in order to achieve a broader application in manufacturing industry, a set of real industrial success stories and best practices is needed. Also the concept of micro factories is still not ready for a broad application, therefore further research and development is needed, e.g. for plant-in-plant structures or mobiles factories, focusing to encapsulation, virtualisation or process interoperability. The potential impact can be outlined by an increased ability to follow market changes, in particular for customised (design-based) consumer goods, and a general reduction of time-to-market. Also the lead times for production, and for development of products and processes will be reduced.

Also the developed methods and technologies for automation of order processing and implementation will significantly improve the efficiency and flexibility of the TCI, in particular for production-on-demand. It is able to to reduce inventory (costs), quantities of unsold products and of returned products. Relevant results are e.g. high quality DTP of smallest fabric quantities, also on different fabric substrates, enabling a higher flexibility regarding answers to market requests, and increased automation of processing the customer order (of the configured product) to the individualised production order (with Bill-of-Material and Bill-of-Labour) to the machine order (e.g. the print job), all aligned with the appropriate configuration space, which is typically settled in the phase of design and development of the good. The developed method of rendering and visualisation of fabrics patterns on garments in 2.5D is one important element in this process, also the simplified way of translating personal data into garment sizes reduces (manual) effort of this processing.

The ability to provide very flexible small series of fabrics and garment has an positive impact to young designers and start-ups of small labels of the fashion industry, thus boosting the creative industries. These industries are considered as an important part in Europe, contributing to the wealth and job creation (see report on EC workshop "New Materials for the Creative Industry" June 2010). Young designers need small amounts of individualised fabrics, typically in very short term. The concept of micro-plants, e.g. for DTP, just enables this. This could be proven by digifabriX, installed in Berlin, where the dynamic landscape of fashion designers is significantly growing.

Open Garments combines mass customisation and open innovation for e-commerce of personalised design-based consumer goods. On-line business, personalisation, customer integration, service-orientation and flexibilisation are the contributing results for impact to industry. For all of them promising means have been developed and are currently exploited. The technological means will be exploited and will increase flexibility and customer-orientation of the industry. The organisational results, in particular the business model, will also contribute. But - it has to be stated that a successful on-line business 24hous/7days

requests a sophisticated and comprehensive design, planning and control of the business processes and the business model.

The consortium expects that industry take-up will need some two to five years, depending on the on-going developments. In all cases it is absolutely necessary to design appropriate application cases together with the decision makers of the SMEs. This often requests an intensive and maybe long lasting work for showing and convincing the concept to them. E.g. in order to deeply understand the full idea and the potential of service orientation, a time period of more than six months is not unusual. Therefore the examples together with the documents of Open Garments provide illustrative examples.

Impact to Society and Consumers

The developments achieved and driven by the Open Garments project will strongly affect society and consumers behaviour on mid - and long sight.

Based on the enriched possibilities for e-commerce the Open Garments results will have an impact on the shopping behaviour in the EU society, in particular regarding customizable made-to-measure products, both in the on-line and the off-line trading. Lean and intuitive sales and customization interfaces simplify access, and do not overburden the customers. Reliable and high-quality order fulfilment processes will raise the acceptance. The process of improving the interfacing, and for extending it e.g. to mobile e-business, using e.g. Smart Phones with appropriate apps, or (ICT) cloud developments, has started, and will further change business.

E-commerce is (to some extend) already standard, but mainly for standard (non- or few configurable) products, mainly of rigid nature. In the field of (configurable) consumer textiles, which typically have no fixed shape, consists of natural raw materials, and depend on the perception of the consumer (in terms of pattern, colour, haptics or lighting), e-commerce has just started; and Open Garments results provide important contributions. This will lead to an increased consumer focus on e-commerce and a as a consequence the use of e-based sales, customization and information options. Getting in touch with this (new) way of interactive shopping, in a consequence, the consumer will even request more and more for such functionalities. On-line commerce is changing general behaviour of citizens in the digitalised society, in particular for the "digital" natives - the young generation.

The custom tailor branch is up to now still an almost traditional offline sector, as most of the sectors dealing with customized (design based) consumer goods. In these sectors so far personal customer contact and skilled personnel providing advisory services was considered to be inevitable. On the one hand this was the result of the fact that there has to be done a lot of effort to transform the customer dialogue into a online functionality, on the other hand the personal contact was important with regard to the shopping feeling and generating trust in the sales procedure.

Open Garments strongly contributed to realize a virtual tailor feeling as well as to simplify the customization process as far as possible. As a consequence the classical barriers for online customizer in the fashion sector were attenuated. But still a lot of improvement is necessary, e.g. regarding a more realistic visualisation of such objects in a web browser.

A second main impact is the possibility of improving products for consumer with special needs and preferences. Up to now these customers have to live with standard products though, or have to go to a custom tailor which means a significant expenditure of time as well as higher prices than average products and mostly a long delivery time. Through the possibility of creating dedicated sales channels for certain consumer groups, such as people with disabilities, reduced mobility, or special body shapes or body perceptions, these citizens will be basically enabled to express garments of their needs and wishes, and - with adapted configuration spaces and order processing capabilities - it will be possible to provide such products at reasonable price and time. The customers will be able to buy and also to design customized clothes and accessories (in the beginning custom shirts, custom fabric and custom jewel) - this will be done in a lean and handy way. There are few data the customers have to measure, via configurator the results can be easily visualize. Additionally the customers are no longer obliged to buy predesigned products but are able to express individual style, or emotions with their designs. Functional and fitting, trendy and fashionable, beautiful and cheap products will become available for the consumer.

Thus the quality of life of these citizens will be increased. And - following the 'Long Tail' fact - such groups, each not so big, form all together a very important part of European society.

A further aspect is social networking, whose importance growing significantly. Such networks not only enable communication between the members, but - organised in dedicated social communities - they will increase the understanding and the knowledge exchange between the individuals, and thus create new knowledge, in this case about fashion, style and fit, and also about design, configuration and even production of individualised goods, and enable to share it across the social network. This will allow to design new things, thus fostering creativity within these networks and between the commercial actors. In particular if community members from divers regions, with divers cultural and professional backgrounds communicate and exchange ideas and thoughts new design and configurations will emerge.

Also the intensified communication, which is sometimes even a collaboration, between producers and users will have a positive impact to society. A better understanding of the "things" behind a product will increase the perceived value of it. The consumer can become aware of the production processes, the materials, and the related consumption of resources.

Finally the concept of networking MicroPlants in or around Europe, together with the MSP and the possibility of the consumer to sell designs and configurations, will contribute to the sustainability of work places and to entrepreneurship. The possibilities of opening a new e-shop, and thus becoming a "business person" (or even an enterprise), with the objective to make money, will not only improve the economical situation, but also increase knowledge and experience of the individual consumers related to this, and thus may increase agility and innovation in Europe.

1.4.2 Main dissemination activities

Focus of dissemination were both online and offline with a big accent to online as the new MSP business model will be accessible online and as the current Internet social media platforms status enable us to do so at very low costs.

Detailed plans for the dissemination of knowledge and results have been developed at project beginning by the partner Boondoggle in close co-operation with all partners. These plans include in concrete terms the dissemination strategy, the target groups and the strategic impact of the new MSP business model. Dedicated dissemination instruments like a dedicated website www.opengarments.eu were used from the start of the project. A wide variety of events and fairs were planned and performed, including multimedia presentations, online advertising, and promotion in online communities.

In the course of the project major conferences have driven hundreds of professionals to hear about Co-Creation and Mass Customisation, including Avantex 2009, IAF world congress 2009, IMB Köln 2009, MCPC World Conference on Mass Customisation Helsinki 2009, Consumer Goods Research Conference Brussels, 2010, 3rd Fashion, Textile & Apparel Conference Istanbul 2010, ICE Conference Lugano 2010, Baltic Fashion Awards, Texprocess Frankfurt 2011, and ITMA Barcelona 2011.

A special event was the final conference and exhibition “Create Your Own” www.cyo2011.com in Berlin, 30-31 May 2011. This joined dissemination event was organized by both SERVIVE and Open Garments consortia in order to promote the concept of Mass-Customization going Fashion to B2B and B2C people:

- A joined documentary film has been produced giving the floor to “Create Your Own” experts and showing “champions” cases to the world.
- The German fashion press has been invited to attend the opening event. The day after, it was a conference day putting together the latest expert worldwide on the “Create Your Own” field like Adidas, Spreadshirts, but also start-ups from Berlin focusing on personalization. Prof Frank Piller’s network has been very helpful here to make it happen. He is indeed the founder of the yearly world Mass Customization Congress. Such a joined dissemination event is a real premiere never ever happened before. It has been a huge amount of efforts to join forces and budgets to make it happen but the results are so good that this idea should be implement again.

Besides these dedicated dissemination activities a set of events has been joined or even organised in the framework of the launching and the demonstration of the Open Innovation Online Consumer Community by KHLim within the so-called 5 waves. In particular Wave 5 with presence of OpenGarments during 5 further events was not only for demonstration, but also to disseminate the concept and the results of tools.

Also more than 80 smaller dissemination activities towards industrial companies and retailer to spread the concepts of consumer interaction and service orientation has been performed by the partners during daily business and consultancy activities (e.g. DITF and CTX presented OpenGarments during the innovation conference at DITF premises in June 2011). A list of dissemination events can be found in the project reports.

Further dissemination was performed using the format of contests: The JewelTweaker contest and the contest for Fabric and Garment design organised by CTX and DITF.

Dissemination material includes offline materials, like Open Garments leaflet/brochure, posters (see example to the right), factsheet, Open Garments standard Powerpoint presentation, Open Garments wall-flag, Open Garments BivOpen Lab, transferred printed logos on garments, collars and cuffs, and the Open Garments logo.

Online material has been produced and used from the beginning. This includes:

- Open Garments Website: www.open-garments.eu
- Open Garments concept film: http://vimeo.com/28945
- Open Garments link building (links from each partner's website to OG website)
- CreateYourOwn film: http://vimeo.com/25132966
- Report about CreateYourOwn event: http://vimeo.com/26028600
- Open Garments community platform: www.opengarments.com
- JewelTweaker http://www.youtube.com/user/jeweltweaker

During the Open Garments project, a paper in the International Journal of Product Development (IJPD) about the blouse sizing using self-reported body dimensions was accepted in March 2011. Prof. Hein A.M. Daanen from TNO Defence as well as Michel Byvoet from Bivolino are the authors. In conclusion, a limited set of self-reported body dimensions can be used to estimate the real body dimensions of females. These body dimensions can be matched with sizing tables to make individual corrections to a garment and improve its fitting.

Further publications include the publication of at the ICE conference Lugano, 2010, or the GWS conference contribution about service-orientation in dynamic production networks.

1.4.3 Exploitation of results

Exploitation planning has been an important activity in the Open Garment project. As described in chapter 1.3 more than ten results have been developed, which are foreseen to be subject of (commercial) exploitation.

In order to achieve the targeted impact a detailed exploitation planning has been started at the beginning of the second project year. This has been done using the EC offer of the Exploitation Strategy Seminar (ESS), where all project partner participated in order to identify and describe the targeted results, the IPR situation and the potential risks.

These results have been updated during a dedicated meeting in spring 2011 in Brussels. The following table shows the results, which are finally subject to exploitation.

#	Result	Type	Main Partner	Time to market
1	Open Garments Platform (Prototype)	Concept and software	DITF, Bivolino, CTX, KHLim	2013/14
2	User data capture (SW+HW) and sizing of individual garments	Service	TNO, Bivolino	2012
3	Visual 3D individual garment design with co-design assistance	Service	EDM, Bivolino	2011
4	Improved and integrated Digital Textile Printing (DTP)	Concept	CTX, DITF, Ergosoft	2011
5	Improved and integrated Rapid Manufacturing techniques	Software	TNO	2011
6	Service oriented Architecture and Utility Services	Software	TXT	2012
7	DigifabriX	Concept	CTX, DITF, Ergosoft	2011
8	Bivolabs, including Garment Print Lab	Concept, Software and Process	Bivolino	2012
9	Manufacturing Service Provider Business Model	Concept	DITF, TNO, Bivolino, CTX, KHLim	2013
10	Community Methodology incl. training material	Concept	KHLim	2012
11	Application Builder	Software	Androme	2013

#	Result	Type	Main Partner	Time to market
12	Color QPC	Software	Ergosoft	2012

Table 2: Overview of expoitable results

For each result a detailed planning has been elaborated (see project deliverable D9.5 “Exploitation Plan"), describing type of result (product, process, SW, service, concept, training), the innovation content of result, customer, benefit for the customer, expected time to market, costs for exploitation, price range, potential market size, competition, protection, market reaction, partners, and a business plan detailing forecasts of costs (marketing, advertising, technical support, product engineering, ongoing maintenance, etc.); forecasts of sales; break-even point and ROI; and technical and commercial risks.

Following this planning the consortium expects that a significant number of results will become commercially available or in use in a very short time, thus contributing to the targeted impact, and leading to the described benefits for industry and consumers.

1.5 Consortium contact details

The following table provides an overview of the consortium and related contact details

Partner	Short name	Country	Contact	URL
Deutsche Institute fuer Textil- und Faserforschung Denkendorf - Zentrum für Management Research (Coordinator)	DITF-MR	Germany	Prof. Thomas Fischer Thomas.fischer@ditf-mr-denkendorf.de Dieter Stellmach dieter.stellmach@ditf-mr-denkendorf.de Alexander Artschwager alexander.artschwager@ditf-mr-denkendorf.de	www.ditf-mr-denkendorf.de
Douëlou N.V.	Bivolino	Belgium	Michel Byvoet byvoet@Bivolino.com Carine Moitier Cmoitier@bivolino.com	www.bivolino.com
Katholieke Hogeschool Limburg	KHLim	Belgium	Niels Hendriks Niels.hendriks@khlim.be	www.khlim.be
Color-Textil Veredlung GmbH	CTX	Germany	Herve Francois h.francois@color-textil.de	www.color-textil.de
FartPol II	FartP	Poland	Jan Sniegocki fart-pol@o2.pl	http://fartpol.grabow.int.pl
Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek	TNO	Netherlands	Jose A. Spruyt jose.spruyt@tno.nl Hein Daanen hein.daanen@tno.nl	www.tno.nl
Ergosoft AG	Ergosoft	Switzerland	Hans Peter Tobler hpto@ergosoft.ch	www.ergosoft.ch

Partner	Short name	Country	Contact	URL
Wetenschappelijk en technisch centrum van de Belgische textielindustrie	Centexbel	Belgium	Myriam Vanneste myriam.vanneste@centexbel.be	www.centexbel.be
Max Juwelier & Edelsmederij	MaxJuwelier	Netherlands	Ramon Kurpershoek ramon@maxjuwelier.nl	www.maxjuwelier.nl
Platico	Platico	Tunisia	Youssef Trabelsi platico1@planet.tn	
Androme Ibérica S.L.	Androme	Spain	Francesc Mateu fmateu@androme.es	www.androme.es
Universiteit Hasselt	EDM	Belgium	Frank van Reeth frank.vanreeth@uhasselt.be Cedric Vanaken cedric.vanaken@uhasselt.be	www.edm.uni-hasselt.be
TXT e-solutions S.p.A.	TXT	Italy	Sergio Gusmeroli sergio.gusmeroli@txtgroup.com Enrico Del Grosso enrico.delgrosso@txtgroup.com	www.txxtgroup.com
Boondoggle B.V.	BoonD	Netherlands	Gaston Serpenti gaston.serpenti@boondoggle.eu	www.boondoggle.eu

Table 3: Consortium contacts

2 Use and dissemination of foreground

2.1 Section A (public)

TABEL A1: LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES

NO.	Title	Main author	Title of the periodical or the series	Number, date or frequency	Publisher	Place of publication	Year of publication	Relevant pages	Permanent identifiers[4] (if available)	Is/Will open access[5] provided to this publication?
1	Open Garments – Consumer Innovation and Open Manufacturing	D. Stellmach	ICE 2010 Conference Proceedings	Annual	ICE Conference	Lugano	2010	pp. 1 - 9		Yes
2	Blouse Sizing Using Self-Reported Body Dimensions	H. Daanen	International Journal of Product Development	Monthly	Inder Science Publishers	London	2011	pp. 341		No
3	Serviceorientierung in dynamischen Produktionsnetzwerken	M. Weiss	GWS - Tagungsband	Annual	Duncker&Humblot	Berlin	2012 (under preparation)			No

Table 4: List of scientific publications

[4] A permanent identifier should be a persistent link to the published version full text if open access or abstract if article is pay per view) or to the final manuscript accepted for publication (link to article in repository).

[5] Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.

TABLE A2: LIST OF DISSEMINATION ACTIVITIES

NO.	Type of activities[6]	Main leader	Title	Date	Place	Type of audience[7]	Size of audience	Countries addressed
1.	Presentation	Bivolino	VAD	07/10/2008	Lille FR	Industry	120	France
2.	Conference	Bivolino	IAF world Congress	30/10/2008 31/10/2008	Maastricht NL	Industry	220	World
3.	Press Release	none	Europees onderzoeksproject "Open Garments"	01/11/2008	Centexbel newsletter, Nr.9	Belgian textile industry		Mainly Belgium
4.	Flyer	DITF, Bivolino, Boondoggle	Project Flyer	01/12/2008	Web Site	Public		World
5.	Press Release	DITF-MR	Project Open Garments	twice a year	DITF Newsletter	German Textile Industry		Germany
6.	Web	DITF, Bivolino, Boondoggle	Project Web Site	01/12/2008	Web Site	Public		World
7.	Conference	DITF	GWS – Gesellschaft fuer Wirtschafts- und Sozialkybernetik	04/12/2009 05/12/2009	Oestrich-Winkel	Scientific Community	50	Germany
8.	Presentation	DITF, Khlim, Boondoggle, Bivolino	Open Garments OI+OM	01/04/2009	Brussels Belgium	Scientific Community	200	Europe
9.	Presentation	DITF, Bivolino	Open Garments OI+OM	17/06/2009	Germany Köln	Industry	100	Europe
10.	Face to face	CTX, DITF	Digital printing processes	13/07/2009	Marc Cain Boblingen	Industry	4	Germany

[6] A drop down list allows choosing the dissemination activity: publications, conferences, workshops, web, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters, Other.

[7] A drop down list allows choosing the type of public: Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias ('multiple choices' is possible.

TABLE A2: LIST OF DISSEMINATION ACTIVITIES

NO.	Type of activities[6]	Main leader	Title	Date	Place	Type of audience[7]	Size of audience	Countries addressed
11.	Presentation	DITF, CTX	DTP information	11/08/2009	CT, Frankenberg	Industry	5	Germany
12.	Presentation	Bivolino	Dissemination	15/09/2009	Lille France	Industry	120	France
13.	Conference	Bivolino , DITF	Dissemination	30/09/2009	ETP footwear conference, Treviso	Industry	65	Italy
14.	Presentation	Bivolino, DITF	Dissemination	06/10/2009	Brussels Belgium	Scientific Community	25	Europe
15.	Conference	Bivolino, DITF	Dissemination	04-07/10/2009	Helsinki Finland	Industry	125	World B2B
16.	Presentation	Bivolino	Dissemination	14/10/2009	Roubaix France	Industry	100	France , Benelux
17.	Presentation	Bivolino, Khlim	Dissemination	16/10/2009	Genk Belgium	Industry	5	Belgium
18.	Presentation	FartPol, CTX	Meeting	16-17/11/2009	Kalisz, Poland	Industry	10	Germany, Poland
19.	Presentation	Bivolino	Dissemination	20/11/2009	Paris France	Industry	5	France
20.	Presentation	Bivolino	Dissemination	23/11/2009	Lille France	Industry	6	France
21.	Presentation	Bivolino	Dissemination	24-25/11/2009	UK London	Industry	5	UK
22.	Presentation	Bivolino	Dissemination	01/12/2009	Tchibo	Industry	5	Germany
23.	Presentation	FartPol	Meeting	07/12/2009	Ostrów Wielkopolski, Poland	Industry	8	Poland
24.	Presentation	Bivolino	Dissemination	08/12/2009	Metzingen	Industry	7	Germany

TABLE A2: LIST OF DISSEMINATION ACTIVITIES

NO.	Type of activities[6]	Main leader	Title	Date	Place	Type of audience[7]	Size of audience	Countries addressed
25.	Presentation	Bivolino	Dissemination	09/02/2010	Diepenbeek	Industry	4	Diepenbeek Belgium
26.	Workshop	all	Dissemination	04/02/2010	ETP	Scientific Community	125	BXL , Belgium
27.	Conference	DITF, Khlim, Boondoggle, Bivolino	Open Garments OI	24-25/03/2010	Brussels, Belgium	Scientific Community	125	European
28.	Presentation	Bivolino	Demo OI (configurator)	2+8/04/2010	Madrid Spain	Industry	5	Spain
29.	Presentation	Bivolino	Demo OI (configurator) & Services	7/04/2010	Frankfurt	Industry	6	Germany
30.	Presentation	Bivolino	Demo OI (configurator) & Services	21/04/2010	London UK	Industry	5	UK
31.	Presentation	Bivolino	Demo OI (configurator) & Services	26/04/2010	Lille France	Industry	4	France
32.	Presentation	Bivolino	Demo OI (configurator) & Services	6/05/2010	Burgkunstadt Germany	Industry	5	Germany
33.	Exhibitions	Bivolino	Mass Customisation congress	19-21/05/2010	Boston, USA	Scientific Community	200	International
34.	Presentation	Fart Pol	Open Garment project	25/05/2010	Art University Poznan Poland	Scientific Community	12	Poland
35.	Conference	Bivolino	Cumulus conference	26-29/05/2010	Genk, Belgium	Scientific Community	230	International

TABLE A2: LIST OF DISSEMINATION ACTIVITIES

NO.	Type of activities[6]	Main leader	Title	Date	Place	Type of audience[7]	Size of audience	Countries addressed
			Borderline					
36.	Presentation	Fart Pol	Presentation of Open Garment project	03/05/2010	Economical University Poznań	Scientific Community	12	Poland
37.	Exhibitions	Bivolino	Congres MC 'Pôle de Technology' Tunesia	10-11/06/2010	Monastir Tunesia	Scientific Community, Industry	150	Tunesia, France, Belgium
38.	Exhibitions	Bivolino	Ecomm Congres	16-17/06/2010	London UK	Scientific Community	100	UK, Benelux, France, Germany
39.	Exhibitions	DITF-MR, Bivolino, CTX	FESPA – Munich	21-26/06/2010	Munich, Germany	Industry	100	International
40.	Conference	Bivolino, DITF	ICE Conference	21-23/06/2010	Lugano Swiss	Scientific Community	125	European
41.	Exhibitions	KHlim	E-Culture Fair	23-25/08/2010	Dortmund, Germany	Scientific Community, Industry, Policy Makers, Medias	100	Belgium, Netherlands, Germany, France, UK, USA, Philippines
42.	Conference	Bivolino, DITF, TNO	EU Manufacture NMP	7-9 /09/2010	Belgium BXL	Scientific Community	100	European
43.	Presentation	Bivolino	UPTEX Mass Customisation	17/09/2010	France (Lille)	Industry	12	France
44.	Presentation	Bivolino	Demonstration	20/09/2010	Hamburg Germany	Industry	6	Germany
45.	Presentation	Bivolino , DITF	Dissemination	24/09/2010	Belgium BXL	Industry	50	European
46.	Presentation	CTX	Interview Magazien	06/10/2010	Large format	Industry	7	European

TABLE A2: LIST OF DISSEMINATION ACTIVITIES

NO.	Type of activities[6]	Main leader	Title	Date	Place	Type of audience[7]	Size of audience	Countries addressed
47.	Presentation	Bivolino	Demonstration	07/10/2010	Amsterdam NL	Industry	40	Netherlands
48.	Presentation	Bivolino	Demonstration	08/10/2010	Madrid El Corte Ingles	Industry	5	Spain
49.	Presentation	Bivolino, Ditf	Demonstration	15/10/2010	Germany	Scientific Community	8	European
50.	Workshop	Bivolino, Centexbel	Demonstration	20/10/2010	Belgium Gent	Industry	150	Belgium
51.	Presentation	Bivolino	Demonstration	22/10/2010	Paris France	Industry	5	France
52.	Exhibtions	Bivolino, Ditf	Demonstration	9-10/11/2010	Germany Köln	Industry	50	Germany
53.	Workshop	CTX	Hamburg Textil Hochschule	25/11/2010	HAB	Scientific Community	15	Germany
54.	Workshop	CTX	ColorManagement and Print	26/11/2010	School-Weissensee	Industry	15	Germany
55.	Presentation	Bivolino	Demonstration	7/12/2010	Diepenbeek Belgium	Industry	3	Belgium, France
56.	Presentation	CT, DITF	Heimtextil	11-14.01.2011	Frankfurt a. M.	Scientific Community, Industry, Society, Medias	200	Germany
57.	Presentation	Bivolino	Dissemination	14/01/2011	Bxl Belgium	Industry	5	Belgium
58.	Presentation	Bivolino , CTX	Demonstration	27/01/2011	Burgkunstadt	Industry	6	Germany
59.	Exhibition	CTX	Munich Fashion	01.-03.02.2011	München	Industry, Society,	100	Germany
60.	Workshop	CTX	Designer Training, Print	15.02.11	Customer, Designer	Scientific Community, Industry,	50	Germany

TABLE A2: LIST OF DISSEMINATION ACTIVITIES

NO.	Type of activities[6]	Main leader	Title	Date	Place	Type of audience[7]	Size of audience	Countries addressed
						Civil Society		
61.	Exhibition	CTX	Berlin Vision	23.-24.2.11	Mr.Nietsche,	Industry	50	Germany
62.	Exhibition	Fartpol	Dissemination	01/03/2011-03/03/2011	Poznań Poland	Scientific Community, Industry	50	European
63.	Presentation	Bivolino	Demonstration	07/03/2011	Antwerpen	Industry	4	Belgium
64.	Presentation	KHlim	Demonstration	24/03/2011	Genk, Belgium	Scientific Community	450	Belgium
65.	Presentation	Bivolino	Demonstration	24/03/2011	Diepenbeek	Scientific Community, Industry	6	Belgium
66.	Presentation	Fartpol	Dissemination	30/03/2011	Economic University Poznań	Scientific Community	80	Poland
67.	Presentation	Bivolino	Demonstration	12/04/2011	Munchen Germany	Industry	6	Germany
68.	Presentation	Bivolino	Demonstration	04/05/2011	Amsterdam NL	Industry	6	Netherlands
69.	Presentation	KHLim	Demonstration and dissemination	12-13/05/2011	Heerlen, The Netherlands	Scientific Community, Industry, Society, Medias	2000	Netherlands
70.	Presentation	Platico, Bivolino	Demonstration	13/05/2011	Monastir Tunesia	Industry	5	Tunisia
71.	Presentation	Bivolino	Demonstration	13/05/2011	London UK	Scientific Community	100	UK
72.	Presentation	Bivolino	Demonstration	17/05/2011	Como Italy	Industry	6	Italy
73.	Exhibitions	DITF-MR, Bivolino	Demonstration	22-24/05/2011	Frankfurt Germany	Industry	6	Germany

TABLE A2: LIST OF DISSEMINATION ACTIVITIES

NO.	Type of activities[6]	Main leader	Title	Date	Place	Type of audience[7]	Size of audience	Countries addressed
74.	Conference	KHLim	Demonstration and dissemination	24/05/2011	Hasselt, Belgium	Scientific Community	400	Belgium
75.	Conference	Bivolino	Demonstration	23-25/05/2011	Barcelona Spain	Industry	120	Spain
76.	Presentation	Bivolino	Demonstration	24/05/2011	Diepenbeek Belgium	Industry	5	Belgium
77.	Presentation	Fartpol	Dissemination	25/05/2011	Poznań Poland	Scientific Community, Industry	35	Poland
78.	Presentation	Bivolino	Demonstration	26/05/2011	Diepenbeek Belgium	Industry	6	Belgium
79.	Exhibition	Ergosoft	Demonstration	30/05/2011	Hamburg, Germany	Scientific Community, Industry	50	European
80.	Exhibition	All	Demonstration and dissemination	31/05/2011	Berlin Germany	Industry	400	International
81.	Conference	Platico, Bivolino	Demonstration	09/06/2011-10/06/2011	Tuni, Tunesia	Industry	125	Tunisia
82.	Workshop	Bivolino	Demonstration	22/06/2011	Brussel Belgium	Industry	4	Belgium
83.	Presentation	Bivolino	Demonstration	15/07/2011	Burgkunstadt Germany	Industry	6	Germany
84.	Presentation	Bivolino	Demonstration	26/08/2011	London UK	Industry	8	UK

Table 5: List of dissemination activities