Digital Archive as a Creative Booster.Connecting Design Processes to Logistics and PLM Platforms.

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Abstract

The research is based on different projects carried out by Sciences for Made in Italy laboratory and REI Design lab (reverse engineering and interaction design) at the University of Florence, in contact with the high-end manufacturing system of Tuscany (Italy). This relation aims at developing design innovation processes in manufacturing, particularly in fashion and high-end production. The research shows how logistics innovation in supply chain processes involving digital archives of semi-finished products, traceability systems and time to market optimization, may represent a real booster for design culture and trans-disciplinary design actions.

The research concerns about collaborations in between University of Florence/REI lab and SMEs, in particular Unomaglia spa leading manufacturer of clothing in jersey fabrics. The company stands as a leader supplier for important Italian and French fashion brands. The research set a digital archive of the manufactured items of clothing based on categories of dress shapes, materials and applied decorations. Digital archiving of items of clothing starts with a photoshooting in a professional photography set, developing 3 several shoots of the item in three different positions. Digital storage system allows to keep under control all the production composition elements, all the different materials and decorations incorporated on the artifact (i.e. embroidery) or applied (i.e. patch systems). Managing these elements we can easily develop design variants, improve the B2B services and product development processes.

The project aims at creating an archive system and logistics management of the supply that represent not only an timing improvement for the supply chain, but above all a way to 'suggest' through the archive items design inspirations and guidelines to designers – i.e. to make their variants on existing semi-finished products or having creative ideas from them. Above all, the research aims at structuring an advanced visualization platform of Product Lifecycle Management, making the artifact in its creative and productive path able to interact to different company departments.

Keywords

Craftsmanship, Design Management, Supply Chain,
Technology Innovation, Logistics

1. Made in Italy Know-How, in between Tradition and Innovation

Since the 1990s the Italian manufacturing sector has faced a series of radical and profound changes, due to the relocation of production and the consequent progressive globalization of the supply chain; the production organization of processes presented an intense transformation and companies had to redesign their structure. The Italian manufacturing districts were the main drivers of international openness of Italy (Becattini 1998; Brusco, Paba 1997; Fortis 1998), but it is interesting to highlight how the Country is strongly characterized by small companies in the same industrial sector and in specific territorial areas in which, although the phenomena of internationalization and globalization, the craftsmanship-based know –how is a centric values (Micelli, 2011).

The Tuscany context, needing to create both structural and organizational renewal, relied on their own experience and expertise to save its peculiarities, setting strategies to maintain and enhance human capital and knowledge of the production districts. In fact, the extreme customization of quality products, which in recent decades has been consolidated in the international markets, has been well implemented by Tuscan companies, and 'interpreted as a phenomenon similar to a craft-based production model, which over time has become a competitive tool and positive differentiator.» (Arrighetti, Ninni 2014). The local production players have been able to generate value, saving their special, distinctive and original knowledge, projecting it into a global vision that enhances the difference. The value of tradition and adaptability of businesses have been reflected in a trading system that has allowed the development of important regional manufacturing areas, this transformation allowed the Tuscany companies to acquire market share and reposition themself in bad and good times, creating a real economic model.

Within contemporary rapid diffusion of digital tools in the enterprises, the research firstly intends to set a picture of 'immutable' elements of production processes, immune since centuries from the processing and manufacturing innovation. Archetypal gestures of mastery and the chain that survive in advanced manufacturing processes; highlighting that the historical knowledge in part 'did not evolve' from the perspective of design strategy and production value chain.
In a world challenged by global manufacturing competition, the value of craftsman “gesture” is transmitted generations by generations and fortunately it has survived thanks to a quality handed down unconditionally. These values are preserved thanks to a strong local characterization and to bond with the Tuscan territory traditions and social values. So the craftsmanship know-how remains unchanged in front of the contemporary transformations due of fast fashion and mass-market phenomena characterizing the globalization processes.
The fashion industry in Tuscany is spread over a large area of the region, from Florence to Pistoia from Pisa to Arezzo, and includes highly specialized productions. Within this sector there are tanning, leather accessories and complete outerwear manufacturers; It still has strong connotations perceivable worldwide both regarding products or processes: the industrial district presents an 'unchangeable' know-how, which is today recognized as a reference for the production of high-end manufactured goods, as textiles and garments, including high specialization of finishing and embroideries

Figure. 1. Leather patterns

The “historical” excellence in manufacturing is connected to sociological values and policies that since the Middle Ages were present in the city centre of Florence. The Guilds know-how was diffused along the Arno River valley creating a production system organizes in districts, full-cycle production areas dedicated to specific manufacturing supply chains. Today, in example, in the Santa Croce quartier, whose name didn’t change since the Middle Age, we find “via delle conce” (leather tanning street) or furriers street, shoemakers and leatherworkers street and many others.

According to the market demand and to a sharp increase in sales, the companies have been reorganized preserving what still distinguishes them: the quality craftsmanship. Other important aspect of their production is represented by the raw material selection in the final product and within the manufacturing process: typical Tuscan leather tanning, produced in Santa Croce sull' Arno – town in between Pisa and Florence - and called 'vegetable tanning,' requires a careful choice of raw hides and alchemical processes, which make this artefact not implementable in a regular industrial environment. In fact, this kind of production requires a complete integration in between artisanal gestures and advanced technology machines as a support for them. This is the reason why we often speck about “advanced craftsmanship” as main value for made in Italy supply chain.

The District of Santa Croce sull' Arno is an excellence in the tanning industry, both in Italy and internationally. In fact, this area produces almost all of the domestic production of sole leather and about 35% of the leathers goods. This is a highly specialized manufacturing processes of fine leather which adopted a water-saving system and environmentally friendly tanning. The attention of high-end manufacturing districts about eco-friendly processes is diffused, even if not always developed in a structured and organized way. Many environmentally friendly production frameworks are coming from the history of manufacturing of a specific city, as a spontaneous process coming from ancient times. We can mention the excellence of “Prato Regenerated Cardato wool”[96] as “ennobled” recycling processes tissue develops a highly reduced carbon emissions according to environmental international disciplinary. The innovation of “cardato” is coming from the Middle Age, when the textile workers of the city of Prato where recycling the fabrics from the Wool Guild of Florence (Padget 2006).

[96] http://www.cardato.it/it/home/

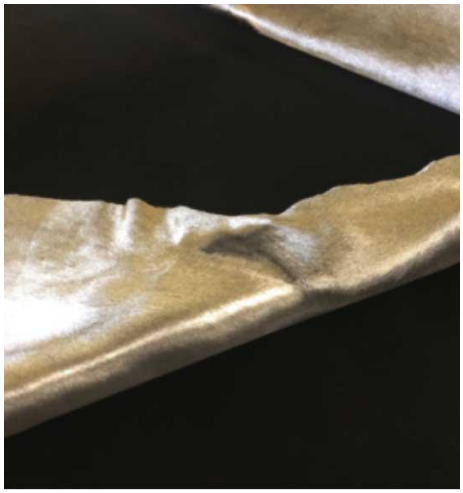

Figure. 2. High-end leather works in Tuscany manufacturing processes

In the last decade we highlighted a significant global business development characterized by emerging large fashion corporations. These financial groups (as LVMH or Kering) need to increase the production, often supporting and reinforcing a renewal strategy of the advanced craftsmanship companies (Goretti, 2017).

Anyway, the production structure did not change. Tuscan artisanal SMEs improved the production by increasing the number of workers and acquiring new machines, not following the rules of the serial production as a way to augment the production outputs. In this phase, the manufacturers also changed the structure of production companies: the emerging influence of the big financial groups and the matter of production development created a kind of 'subjection' by those companies to the big global “griffes”. The manufactures become contractors or suppliers contractors, in a solution of high dependence from the brands. Meantime, we highlight that for them is increasingly more difficult than in the past to present their own trademark with a proper positioning in the global market.

Figure. 3. Leather cutting by hand following the pattern guidelines

Then, the craft-based manufacturers organized themselves in the production chain, maintaining and caring about their traditional production skills but in a more structured supply-chain in touch with the international corporations – often more involved in financial interests than into real production matters.

So, “Why all the fashion design world” - with an obvious reference to the high-end products- “decided to produce its leather goods and much of the outerwear in Tuscany”? The answer is generally based in the integration of craftsmanship with some significant innovation processes. It has come to advanced craftsmanship processes enhancing creative development of the artefact and a manufacturing flexibility. This model is able to develop technology transfer paths and cross fertilizations among SMEs, a company network standing as a one-of-a-kind case-study in worldwide.

Another interesting aspect of contemporary transformation of made in Italy manufacturing districts is the reorganization of management and of the supply chain in progress: financial holding companies “acquire” SMEs and then the artisans know-how. By monitoring the contemporary Tuscany fashion sector we highlight that new and significant investments are structuring what could be defined as a cluster of “industrial crafts”, a new training model for the new craftsmen and a new strict and often innovative business organization centralizing the workers in specific integrated SMES under the direct control of the financial group. The corporations involved in this process are often international and position the tangible and intangible values of high-end craftsmanship at the centre of the value chain and. In particular large international groups like Kering, LVMH or the Prada group are setting and developing new technological tools for supporting and promoting the 'Advanced Craftsmanship' values and the endogen propensity of the SMEs to merge innovation processes into the artisanal heritage.

Summarizing, we can highlight specific invariants of Made in Italy craftsmanship:

a) Technology transfer skills of SMEs:
This concept is, often, a phenomenon endogenous of the advanced craftsmanship, a dialectical relationship “transferor-transferee” between the operators of the production district for product development and production. Otherwise, actions of "productive transfers" from one sector to another allow the manufacturer to develop and to implement a particular technology in different product areas. These transfer processes lead to application of knowledge into new product areas with a "self-discipline" attitude of companies, without any industrial innovation plan previously defined.

b) Innovation cross-fertilization:
Exchange of production processes and transfer of knowledge in between different productive sectors, establishing new supply chain clusters, changing the traditional framework of the manufacturing chain.

c) The persistence of traditional “craft rituals" within advanced craftsmanship context: We can often find key elements of the supply chain arising as “invariants” elements of manufacturing process. These artisanal rituals are since centuries immune from transformation and innovation of production systems, as “archetypal gestures” of craftsmanship.

d) Logistics innovation in the supply chain:
Innovation in production logistics and management of subcontracting in the area are strategic elements to make craftsmanship processes effective in the market.

Even if we can notice a significant propensity of Italian manufacturing SMEson technology innovation within the supply chain and, although we highlight a significant efforts of large fashion corporation on supporting the innovation processes in fashion production, the state of the art of digital technologies involvement in Italian production districts stands a peculiar.

Fashion manufacturing is thereby substantially involved in the process of digital transformation thanks to the opportunities offered by the Industry 4.0 program, part of Smart Factory/Horizon2020 framework[97]. Cisco Italy, within Digitaliani program, has devoted a special section to the acceleration of digitalization in manufacturing. 'Thanks to the work done so far,' says Michele Dalmazzoni, Sales Leader of Cisco Italy for Industry 4.0 – we were able to put the digitalization matter at the centre of the national scene, the institutions have invested on additional substantial incentives that may affect truly and deeply on the Italian industrial sector. Italy, from the digitalization point of view, present a contradictory situation: on the one hand we find some excellences, on the other hand there is a very wide range of businesses where most companies that even present significant lacks 3.0 technologies. The Italian manufacturing industry consists of many companies that concentrate their strength in the handicraft and handmade products; even within the same company production chain sometimes there isn't a common level of digitalization among the different sectors or processes.

Making a comparison to other Italian industrial sector we can highlight substantial differences. In example, in the production of machinery and mechanical components the implementation of digital innovation processes is more advanced, due of the need of supply chain automation. Then the presence "traditional" or even manual processes and advanced technologies in the fashion supply chain make the introduction of digital technologies more difficult and complex.
The research present some joint activities developed in between University of Florence and fashion SMEs based in Tuscany, aiming at highlighting how digital technologies and in particular digitalization of advanced craftsmanship could develop a new path for manufacturing and business innovation.

2. Digital Archive as a Design-Driven Tool: Improvement of Time-to-Market and Design Innovation through Creative Cross-Fertilizations.

2.1 The case history of Digital Archive in Textile Manufacturing – promoted by Museo del Tessuto Prato[98] (Italy)

The project will develop a study of digital archiving of materials and manufacturing processes, including software and hardware platforms and advanced scanning test systems. The project aims primarily to digitalize the manufacturing process of Texmoda srl, historical Prato's company, by creating a digital archive about product development practices and company subcontracting relationships. In addition, this new digital tool could enhance the intergenerational transfer of knowledge about supply chain for textile and items of clothing. The research will produce digital archive platform and a dynamic storage system — a digital prototype system for consultation of the archive that can lead the industry, the buyer or the buyer to interact directly to the materials and brand values Texmoda enclosed in the storage. The dynamic system also wants to identify way of consultation, redesign and optimization of

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https://ec.europa.eu/digital-single-market/en/news/info-session-horizon-2020-digital-manufacturing-platforms-connected-smart-factories
98 http://www.museodeltessuto.it

textile design and production chain. The project aims at identifying the best software and hardware solution for the digital development and user-interaction systems, aiming at optimizing the time-to-market, the consultation systems and dynamic redesign frameworks. The research will archive a “pilot” quantity of textile materials that aims at defining best practice by using this digital platform, and to set the effectiveness of the tool within the business processes of the company. The research also aims at implementing the existing company management software with the digital archive system, in order to reduce the time between the management planning and production issues as, in particular, product development, material selection and tailor-made prototypes for specific clients.

2.2 Research Ricamo 4.0[99] in partnership with RCT Embroideries – Florence (Italy)

Ricamo 4.0 is a research project aimed at developing an online digital archive of embroidery that bring innovative advantages within the supply chain, making the industrial process more competitive in the context of the new 4.0 industrial revolution. The project focuses on high-end made in Italy production system, Italian symbol of global excellence born from the meeting between traditional knowledge in craftsmanship and new technologies, giving rise to what is called “advanced craftsmanship”. The work focuses on the sector of the Fashion Business and in particular on textile and embroideries manufacturing in contact with global fashion brands such as Prada, Giorgio Armani, Valentino, Gucci, Versace, Dolce & Gabbana, Roberto Cavalli. The research is developed in partnership with the company RCT srl, supplier of famous global international brands.

In recent years, the rapid prototyping technologies have allowed in this field in developing new production methods and the opening of different production and B2B and B2C sales channels, making the companies decreasing the time-to-market, which is the time between the creation of the product and its positioning in the market. The fashion production SMEs that improved this aspect of their business become more competitive on today's market, evolving the “speed” of the B2B network. By CAM/CAD and 3D printing technologies, working on the acquisition of geometries using 3D scanning (Reverse Engineering), the production process is becoming faster, making faster the transposition from digital systems to physical product (and viceversa). The research aimed at creating an online digital archive for the embroidery industry, making fashion manufacturing based on advanced craftsmanship (Goretti, 2017) able to improve their design management processes and the design services offered to the clients.

The project, carried out by the research team of the University of Florence in collaboration with RCT, SME specialized on high-end embroidery based on craftsmanship and innovative lased cutting processes, aims primarily at creating a digital storage to enhance the enterprise samples and then to improve the B2B processes.

First of all, a digitalized taxonomy of samples supports the supplier on establishing business relations and sharing information with the client, being a company always a contractor or sub-contractor for important international fashion brands. In fact, RCT produces semi-finished products not addressed directly to the end user, but embroidery items to be applied on clothes or fashion accessories.

Secondly, an online catalogue of samples supports the direct contact in between external designers or a stylist (as freelance professionals or employee of fashion corporations) and the

[99] Research developed by Martina Grillo, supervisioned by Gabriele Goretti, Elisabetta Cianfanelli.

production company. The manufacturer could offer to the design professionals a more flexible and open approach to the creative requests, based on tangible and implemented case histories of semi-finished and finished product included in the archive. So, based on previous production experiences and already tested manufacturing processes the company presents itself with a new design oriented approach open to innovative shapes and details, without changing the regular processes of supply chain. The archive could be accessible online through the website of the company: the area is accessible to the clients by personal credentials. An initial exploratory “section” shows the entire photo archive of production items grouped by type of work and the “custom” section shows the 3D model of selected as basic shapes for additional customizations. On this page we can change the colour of the materials and the yarn. The visitor could also get an idea of the finished product, by the visualization of possible finished accessories or clothes including the selected features. Once the customer chooses the preferred combination, the software will generate the price and delivery date. The digital rendering process starts from the 2D vector drawing, processed using 3D modelling and rendering software.

The advantages of this approach are as follows:
- Innovation within the supply chain without changing the traditional processes;
- Direct communication between designers and contractors;
- Complete and updated proposal for design departments;
- Feasible management investments for small/medium-sized enterprises;
- The archive can be used as a internal resource for the company itself (to improve the production chain);
- Accessibility and immediate communication via web;
- Defining a new user experience for customers;
- New opportunities to set a sample before the real production, avoiding traditional prototyping matters and costs;
- Automatized management of the order.

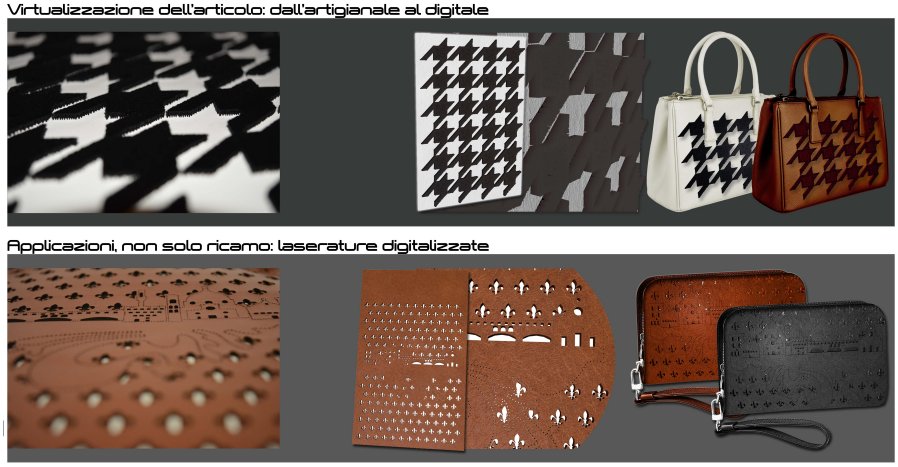

Figure. 4. Ricamo 4.0 – visualization framework

2.3 Unomaglia Digital Archive[100]

Unomaglia s.p.a. is an Italian leading supplier in the production of high-end men's and women's clothing, mainly specialized in the production of jersey apparels. The company operates according to a specific multi-brand strategy, producing for the main fashion brands such as

[100] Research developed within the University-Company agreement 2016-2017.
www.unomaglia.it

Gucci, Hermes, Chanel, Dior, Versace and Givenchy, with customized solutions specifically designed for the client.

In recent years, Unomaglia has seen an important growth due to both a winning diversification strategy and the extension of the selling preposition, expanding production to swimwear and lingerie. Thanks to this substantial growth, the company manifested the need to develop a digital archive that would host all the products and processes made by Unomaglia from the early beginning of its activity, in 1987. The first objective in this project was to elaborate a method for digital archiving of clothing products with the aim to have a quick report from each and to read faster all the information about characteristics and processes. This method should firstly allow at building a digital archive of the company as it is, and then should allow the company staff -in autonomy- to perform future operations aimed at including new items in the archive.

Although the project team had expertise in the implementation of digital archiving methods for high-end manufacturing products, this case presented some difficulties in the fact that clothing product has peculiar characteristics that need to be enhanced and some obstacles related to the consistency and the structure of the product itself. For these reasons the team decided to operate with a photographic archive, in order to make the digitization process more manageable, without losing in quality. For the occasion, a software generally used in the jewelry field was adapted to the specific needs of the company; operating a technological transfer of techniques and skills the team developed a method for archiving about three thousand two hundred products. This software controls and fully manages the camera connected to it. It allows the operator to have a preview of the shots directly on the PC screen, to obtain scale 1:1 images, with a completely white background, without shadows. The software also allows to manage the sizing of images, to create catalogues in different file formats and 3D videos. In order to develop a successful archiving method it was necessary first of all to design the way of inserting the products in the software, second to plan the structure that the archive would have had, also in relation to the further uses. The first step was, therefore, to assign hierarchies and form "families" of products, activities that are fundamental considering the importance of details and workmanship in a fashion product.

Each product has been given an article code, a barcode to be read with a specific optical reader, a brief description of the materials and workings carried out on the garment and specific notes regarding the production batch code, the brand and the reference collection. Each garment has been labeled according to a specially developed layout and a molding system that communicates with a catalogues that can be consulted both online and on paper. A key part of the development of the archiving process was identifying the keywords that would work as tags for future research of archived products. The tags concern the specifications of the fabrics, the type of product, the brand, the workmanship, any decorations, embroidery or applications, color etc.

Figure. 5. Unomaglia Photoshooting and archive setting

2.4 Digital Archive and Product Lifecycle Management

Then, the traceability of the items within the digital archive allows at connecting the innovation in management and logistics in manufacturing and the creative design processes. The design and prototyping phases and then the production processes and the product quality check steps could be included in the same process, developing a coherent framework of product lifecycle. Product Lifecycle management is an emerging matter in manufacturing “Made in Italy” SMEs. The combination of craftsmanship processes and advanced machines application within the supply chain has often created problems and obstacles in introducing PLM new generation software in the production line. Digital archive could represent a new significant new step in this innovation process and PLM possible implementation.

Within the joint-labs Academia-Company, The University of Florence research team established a continuous interaction in between some companies developing their customized digital archive -including qualitative and quantitative values- and craft-based and advanced works aspects in a complex taxonomy of information and tutorials.

The confront in between SMEs and some PLM Italian start-up companies introduced a new perspective in customizing traditional product lifecycle processes, often developed for big corporations by global PLM platform, to the needs of Italian high-end manufacturing companies. Through the PLM, it would be possible to control and to trace the full artifact framework, from the concept to the prototyping, then from raw materials procurement and production setting to the final implementation. In addition, we can have a proper check on the quality control and to communicate to the B2B or B2C customer the values of the item embedded in every step of the supply chain. So Design process could be more integrated to the supply chain, the design improvement and design implementation test could be set and archived as a values, the connection between the concept and the artifact creation could be set and communicated in a complete way. So PLM could represent an additional support for the creative processes, for craftsmanship values and for the item authenticity.

3. Conclusions

The research results explained above presented, express how innovation in company organization, management and logistic could be related to the creative aspect of design, in particular in creative industries areas as high-end fashion. Italian SMEs companies, often based in as historical craftsmanship know-how, need a new phase of systematization and reorganization supported by digital technology platforms. This management resetting could

also enhance a new “creative” booster, making the traditional skills - related to the quality in manufacturing and composed by historical artisanal rituals and new machine application – as a global values, with a proper time to market, so able compete in the international fashion scenario.

The emerging demand for the high-end manufacturing stands often as an increasingly hard matter. The complexity of the fashion collections in clothing and fashion accessories, the miniaturization of manufacturers in comparison to the large financial corporations and, in addition, the emerging pressure made from the market timing to the production processes force the SMEs network to set new operational devices and platforms.

Then, Digital archives and new PLM platform according to the specific company need and processes could represent a new digital stage, able to support and to enhance the craftsmanship values in quality and creativity within global fashion business.

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