

22



FASHION AND  
TEXTILE DESIGN  
AMBIVALENCES



**PAD. Pages on Arts and Design**

International, peer-reviewed,  
open access journal  
founded by Vanni Pasca in 2005

**Editor-in-Chief**

**Marinella Ferrara**  
Politecnico di Milano, Italy

**Advisory Board**

**Tevfik Balcioglu**  
Arkin University, Kyrenia, Turkey  
**Murat Bengisu**  
Izmir University of Economics, Turkey  
**Isabel Campi**  
Design History Foundation, Barcelona, Spain  
**Eduardo Corte Real**  
UNIDCOM/IADE, Lisbon, Portugal  
**Antonio da Cruz Rodrigues**  
Universidad Lusofona, Lisbon, Portugal  
**Soumiya Mikou**  
Moroccan Design Association, Casablanca, Morocco  
**Ely Rozenberg**  
RUFA, Rome University Fine Art, Italy  
**Mireia Frexia Serra**  
Gracmon, Universitat de Barcelona, Spain  
**Andreas Sicklinger**  
Università di Bologna, Italy  
**Fedja Vukić**  
University of Zagreb, Croatia

**Managing Editor**

**Chiara Lecce**  
Politecnico di Milano, Italy

**Editorial Assistant**

**Giorgia Bonaventura**  
Politecnico di Milano, Italy

**Editorial Board**

**Giuseppe Amoroso**  
Politecnico di Milano, Italy  
**Helena Barbosa**  
University of Aveiro, Portugal  
**Stefania Camplone**  
Università di Chieti-Pescara, Italy  
**Roberto De Paolis**  
Politecnico di Milano, Italy  
**Cinzia Ferrara**  
Università degli Studi di Palermo, Italy  
**Francesco E. Guida**  
Politecnico di Milano, Italy  
**Ashley Hall**  
Royal College of Art, London, England  
**Elif Kocabiyik**  
Izmir University of Economics, Turkey  
**Lia Krucken**  
Creative Change, Brazil and Germany

**Carla Langella**

Università degli Studi della Campania Luigi Vanvitelli, Italy

**Giuseppe Lotti**

Università di Firenze, Italy

**Tomas Macsotay**

Pompeu Fabra University, Spain

**Nicola Morelli**

Aalborg University, Copenhagen, Denmark

**Alfonso Morone**

Università Federico II, Napoli, Italy

**Raquel Pelta**

Universidad de Barcelona, Spain

**Daniele Savasta**

Yaşar University, Izmir, Turkey

**Alessandro Squatrito**

Politecnico di Milano, Italy

**Rosanna Veneziano**

Università degli Studi della Campania Luigi Vanvitelli, Italy

**Li Zhang**

Beijing Information Science and Technology University, China

**Publishing Consultant**

**Vincenzo Castellana**, Architect, Italy

**Art Direction**

**Francesco E. Guida**

**Web Site**

**Pietro Forino**

**Correspondents**

**Amina Aguezmay** (Morocco), **Hèla Hamrouni** (Tunisia),  
**Vesna Kujovic** (Montenegro), **Can Özcan** (Turkey),  
**Ana Perkovic** (Croatia), **Filip Roca** (Montenegro),  
**Azadeh Sabouri** (Iran), **Marco Sousa Santos** (Portugal),  
**Pascale Wakim** (Lebanon)

**Reviewers**

Murat Bengisu, Cristina Carvalho, Roberto De Paolis,  
Annalisa Di Roma, Claudio Gambardella, Solen Kipoz,  
Vittorio Linfante, Gianni Montagna, Gabriele Monti,  
Carla Morais, Maria Antonietta Sbordone, Benedetta Terenzi,  
Davide Turrini

**PAD**

via Festa del Perdono 1 – 20122 Milano – Italy  
via Roma 171 – 90133 Palermo – Italy  
info@padjournal.net – editors@padjournal.net

**Publisher****Aiap Edizioni**

via A. Ponchielli 3 – 20129 Milano – Italy  
aiap@aiap.it – www.aiap.it

PAD © ISSN 1972-7887

#22, Vol. 15, June 2022

[www.padjournal.net](http://www.padjournal.net)

## 0. EDITORIAL #22

### Fashion and Textile Ambivalences

by Gianni Montagna & Maria Antonietta Sbordone

006

## I. NEW/OLD ADVANCES

### Fashion Heritage and the Value of Time. The Dual Role of Archives for Sustainable Acting

by Margherita Tufarelli

018

### Analysis of Emotional Experience related to Sensory Perception of Woven Textiles based in the UK

by Gina Nadal Fernandez

042

### Smart Tags as a Tool for Circular Economy in the Textile and Fashion Chain

by Adriana Yumi Sato Duarte, Regina Aparecida Sanches, Rayana Santiago de Queiróz & Fernando Soares de Lima

069

## II. NEW/OLD PRODUCTION AND CONSUMPTION APPROACHES

### Sustainability in the Prato Textile District: Vanguard and Tradition

by Debora Giorgi, Renato Stasi, Margherita Tufarelli & Maria Claudia Coppola

087

### Product & Textile Design Interventions on Circular Sustainable Systems. Enabling Coherent Projects that Preserve a Balance within their Context

by Jose Luis Gonzalez Cabrero & Ana Margarita Ávila Ochoa

110

### Unlocking Competitive Advantages in Sustainable Namibian Fashion through IK, Indigenous Materials and Design

by Beata Hamalwa

129

## III. NEW/OLD FEATURES

### Scenarios: Strategic Tools for a Reflective Fashion

by Maria Claudia Coppola & Elisabetta Cianfanelli

155

### Strategies for Sustainability and Circularity: a New Value Chain for the Fashion Industry

by Rosanna Veneziano, Francesco Izzo & Michela Carlomagno

177

### Fashion-Oriented Bio Textiles: the New Speculative Aesthetics of Biocouture

by Chiara Scarpitti

201

#### **IV. PROJECTS & DOCUMENTS**

##### **Interview to Mauro Vismara (MAEKO)**

by Gianni Montagna & Maria Antonietta Sbordone

**225**

#### **V. BIOGRAPHIES**

##### **About the Authors**

**236**

# NEW/OLD ADVANCES

# Smart Tags as a Tool for Circular Economy in the Textile and Fashion Chain

**Adriana Yumi Sato Duarte**

University of São Paulo

Orcid id 0000-0003-4441-2691

**Rayana Santiago De Queiroz**

Institute for Technological Research

Orcid id 0000-0003-1148-5595

**Fernando Soares De Lima**

Institute for Technological Research

Orcid id 0000-0002-0385-5958

**Regina Aparecida Sanches**

University of São Paulo

Orcid id 0000-0003-2489-8540

## Keywords

Circular Economy, Smart Tag, Textile and Clothing Chain, Post-use, Discard.

## Abstract

Fashion is one of the most important industries in the world. It is complex chain and involves other industries in its processes, making it difficult to make a complete comparison in terms of pollution and socio-environmental impacts with other sectors. Socio-environmental sustainability is a relevant variable for fashion consumption, currently consumers demand greater transparency from companies, seeking to know where, how and who produced the product.

The main objective of this research is to propose the use of smart tags for textile products, containing information on the steps and processes involved in the production of the textile article, in addition to guiding users and manufacturers in the post-use and recycling step as strategy to reinsert these products into a new production cycle.

The knowledge of the impacts of the processes inherent to this extensive chain, the need for production transparency, performance and lifecycle of these products are important to establish not only management policies and reduction of disposal of post-use textile products, but also the interface with an increasingly conscious, demanding and engaged consumer.

## 1. Introduction

From the prevailing logic of production and consumption in the Fashion system, environmental and social problems on a world scale have emerged. Based on productive systems of linear economic orientation (extract-transform-use-discard), the textile and clothing industry is one of the main responsible for large-scale consumption and misuse of natural resources (Clark, 2008; Fletcher, 2014; Roy Choudhury, 2014). Faced with this scenario, we are driven to seek solutions for the textile and clothing sector that can subsidize not only new patterns of production and consumption, but also more efficient textile waste management systems, based on a circular economy model. By definition, the circular economy is related to a sustainable cycle, from production to the reinsertion of the raw material for the manufacture of a new product (Avila et al., 2018). One way to connect the chain and supply information about the textile material produced is through the use of Smart Tags: tools that create traceability of the production process, connect the entire chain, in addition to allowing the user to access product information and how it was produced. In the disposal phase of this material, it is possible to identify the raw material that was used and thus return the product to the production cycle in an appropriate manner. In this context, the main objective of this research is to propose the use of smart tags (Smart Tags) for textile products, containing information on the steps and processes involved in the production of the textile article, in addition to guiding users and manufacturers in the post-use stage, applying recycling as a strategy to reinsert the discarded articles in a new production cycle.

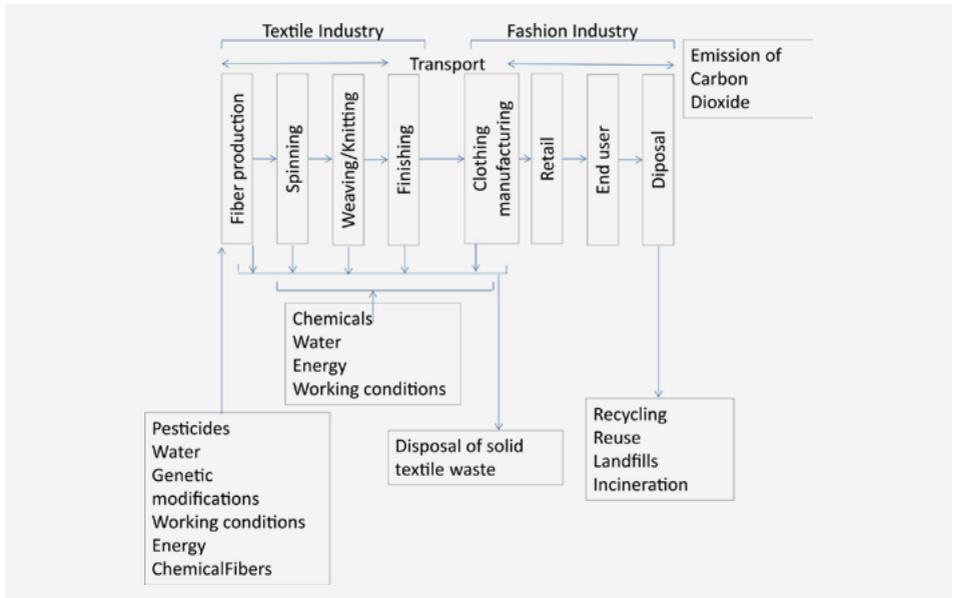
## 2. Technology, Information and Communication Tools

Technology occupies a large part of modern life; we live in a networked society, in which information is considered the *raw material* of social systems. Currently described by Castells (1999) and Bauman (2001) as a networked society that takes advantage of the global highway, telecommunications, virtuality culture and breaking the models of time and physical space so that individuals are able to perform multiple tasks. Castells (1999) describes the existence of a rapid Information and Communication Technologies (ICT) diffusion and that information is considered a *raw material* of social systems. Production systems are changing due to a new industrial revolution underway. Having access to information and data does not necessarily mean that this content is representative and reliable (Desouza & Smith, 2014). The main challenge of this system is the creation of a mechanism that links data from different sources and that allows the real-time transmission of results from one module to another to create a database. Kamrani (2008) states that this is a problem that requires a quick solution, mainly due to the need to maintain relationships and dependencies between the different types of data collected. Smart tags are microchips that can be attached to products to allow their contactless identification using radiofrequency (Feldhofer, 2004). Associated with an enterprise information systems architecture, it can play an important role as a solution for a hybrid enterprise information systems architecture, consisting of IoT applications and a blockchain supporting transaction services within a global clothing business with several parts connected to the network. IoT is a smart global network of interconnected objects, which through unique ad-

dress schemes can interact and cooperate with their business partners to achieve common goals. Data obtained from IoT applications throughout the apparel business processes can greatly facilitate operational and consumer decision making (Pal & Yasar, 2020).

### 3. Fashion Chain: Production Processes and Social and Environmental Implications

The fashion production chain, unlike other value-added chains, has a large number of stages in the process, carried out by different successive industrial units. As shown in Figure 1, it comprises the following steps: fiber production, spinning, weaving/knitting, textile processing, clothing, wholesale/retail sales, use/consumer and disposal (Tobler-Rohr, 2011a).



**Figure 1.** Flowchart of the fashion chain, main environmental and social impacts in fashion chain, adapted from Farias (2016).

Several of these units operate in a disintegrated manner, with different stages developed by different companies (Tobler-Rohr, 2011a). The complexity and fragmentation of this supply chain thus inevitably leads to a lack of transparency about the various stages involved in the manufacture of products and their potential environmental and social impacts (Roy Choudhury, 2014).

For the production of a simple clothing piece, it is necessary to trigger a large number of production processes that can generate more or less significant impacts. In the production of fiber, problems stand out both in the agricultural activity associated with the use of fertilizers, herbicides and insecticides, and by the extraction and conversion of oil for the manufacture of synthetic fiber (Fletcher, 2014; Slater, 2003, 2008; Tobler-Rohr, 2011b). In yarn production, environmental effects include those caused by chemicals used in washing, cleaning, bleaching, along with the emission of gases from drying machinery, opening and carding operations (Slater, 2003; Tobler-Rohr, 2011b). Similar problems are observed in the textile production, where chemicals, fiber residues and noise are also present. Finally, the stages of the finishing process concentrate most of the known impact activities, especially the dyeing and printing processes, which result in the contamination of a huge volume of water by products discarded such as toxic and/or carcinogenic dyes and other chemicals (Roy Choudhury, 2014; Slater, 2003; Tobler-Rohr, 2011b). It is important to note that, in addition to the problems mentioned, all material derived from the production of the textile and fashion chain industries, is generally discarded and causes impacts on the environment.

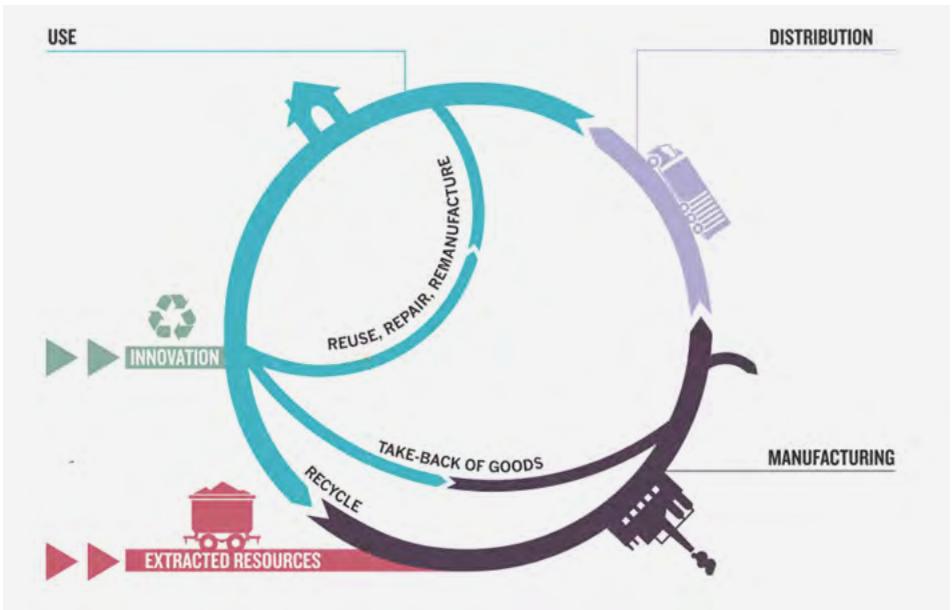
Lorenzetti (2018) reports that the textile sector in general produces little material waste in relation to its production, with many companies already reprocessing wastes. However, the manufacturing stage discards an average of 10% of all fabric used only in the cutting process.

When the product is in use, one of the most critical issues is its premature disposal, either due to its low quality, or because it no longer meets consumer requirements, for example, those motivated by fashion trends (Slater, 2003). Studies carried out in recent years show that for the fast-fashion model to support itself, the production of clothing has doubled in the last fifteen years and the average number of times each item is used has decreased by 36 %.

#### **4. Circular Economy: Concepts and Definition**

The productive process of the circular economy model contemplates the reduction, reuse, recovery and recycling of materials, in a sustainable cycle from production to the reinsertion of raw material for the manufacture of a new product (Avila et al., 2018). Figure 2 illustrates this model.

According to Pearce and Turner (1990), the concept of circular economy was conceived in the early 1990s; in this model there are no discards of materials or products produced, the destination and recycling of waste is defined in all stages of the process. Production process, from product design to post-consumer disposal. Leitão (2015) adds that the model is based on nature itself, it is implemented through innovation, design and processes that aim to reduce the consumption of raw materials, energy and water.



**Figure 2.** *Circular production model*, circular production dynamics with phases and gates, adapted from Stahel (2016).

The circular economy model and the concepts Cradle-to-Cradle (C2C) or Life Cycle Assessment (LCA) can be used as a strategy to reinsert the waste generated by industries in a new cycle, reducing its impact on the environment.

#### 4.1. Circular Economy in the Fashion Chain: Problems of Post-use Disposal

In view of the environmental problems of the textile and apparel chain, associated with the consumption dynamics imposed by the fashion systems (such as fast fashion), many processes and inputs used in the fashion chain have been reevaluated and new production and consumption alternatives have been exploited (Fletcher, 2014), spreading the concept of conscious consumption more widely. There is also an engaged consumer

whose purchase is determined by a rigorous choice process. A Fashion product that follows the dynamics of technological developments and, at the same time, is manufactured from a new business model that prioritizes social, environmental and functional aspects, is a way to allow the union of these scenarios and meet the demands of both the producer and consumer. The fabrics used in garment production are generally produced by weaving and knitting techniques, that can be of natural origin – made from fibers obtained from renewable sources and decompose quickly in the environment – or produced from natural polymers, renewable raw materials that decompose quickly in the environment or from synthetic polymers, mostly petroleum-based, and take decades to decompose in nature. To change the linear economic model to the circular model in the textile and apparel chain, it is necessary to intervene in all its production systems. The textile fibers production is one of the biggest challenges of the sector, because instead of removing the raw materials from the nature it will be necessary to recycle textile products discarded by consumers. In this way, the textile articles can be transformed into recycled fibers, that will be used in the manufacture of the recycled yarns, and in the production of fabrics.

According to Fletcher and Grose (2011), the improper disposal of textile waste causes climate change, adverse effects on water and its cycles, chemical pollution, loss of biodiversity, excessive or inappropriate use of non-renewable resources, negative effects on health and harmful social effects on producing communities. The Ellen MacArthur Foundation (2017) points that about 100 billion clothes were produced in 2015, approximately 70% of these clothes were discarded in landfills or incinerated.

## 4.2. Circular Economy in the Fashion Chain: Recycling and Reuse

Discarded textile articles can be used in the manufacture of recycled yarns, through mechanical or chemical recycling processes. In the mechanical recycling process, the articles discarded at the collection points are sent to recycling cooperatives where the following steps are carried out:

- **Sorting:** to separate the types of materials used in the manufacture of the items;
- **Cleaning:** the articles are washed and dried in a industrial machine;
- **Disassembling:** the textile material is separated from the accessories (zippers, buttons, other materials, etc.);
- **Fragmentation:** the fabrics/knits are perforated to standardize the material to be recycled. The machine used for the fragmentation stage has metal detectors and perforates entire garments.

The perforated material is processed by a textile shredder machine, to transform the confection scraps into recycled fiber, which will be sent to the spinning mill and used in the manufacture of a new product (Amaral, 2016). In the chemical recycling process, the fabrics are perforated, dissolved and recovered, then sent to chemical spinning to be transformed into new fibers (Fletcher & Grose, 2011).

In this way, the garments discarded by consumers can be recycled using the circular economy model and transformed into new products; the accessories, separated at the beginning of the process, are normally used in the manufacture of handicrafts.

## 5. Proposal for a Smart Tag in the Textile Product

The lack of identification of the origin of the textile raw material is one of the factors highlighted as barriers to the implementation of the circular economy in the textile sector (Mangla et al., 2018). In this sense, the material to be reprocessed must be properly identified and stored so that it can return to the production cycle. In the circular economy paradigm, consumers should be encouraged to classify each type of textile fiber before disposal. The low reliability of the currently labels becomes a relevant factor in consumer participation in the classification of the textile (Jia et al., 2020), requiring a more robust and comprehensive system.

According to Pal and Yasar (2020), the scenario faced by textile manufacturing companies is challenging due to the volatility, uncertainty and complexity associated with constant changes in consumer behavior, where demand for lower prices, better service and mobile commerce are constant.

### 5.1. Smart Tag Guidelines: Consumer

The consumer plays an important role in boosting the application of the Circular Economy. This should put pressure on suppliers to be committed to aspects of economic, social and environmental sustainability.

For the consumer, access to information on the raw materials used, companies involved and engaged in socioenvironmental causes and a closer relationship with the people involved can generate added value in a given product and an identification with the brand. In addition, in the context of circular economy, it is important that the consumer knows what raw material is used in the production of the textile article to provide

a proper disposal. This can be done with smart tags attached to the article that communicate with smartphones and displays in stores, for example. This communication can generate a connection between the end user and the employee who worked on the production process of that product.

In this context, the smart tag can be used to provide information such as:

- A video containing an employee's report of the production process, generating empathy for the consumer, and connecting the consumer to those who were involved in the production process. In this way it is possible to generate identity with the brand and for the consumer the certainty that the process is socially correct.
- Information on the raw materials used, allowing the user to select products that are in accordance with their lifestyle in addition to guiding the appropriate disposal.

### **5.2. Smart Tag Guidelines: Manufacturer**

With proper identification previously made by the consumer, the manufacturer is able, more efficiently, to track the use of certain materials and end-of-use of the textile article so that they return to the cycle of the circular economy, using the mechanical recycling process or chemistry as described in item 4.2.

### **5.3. ReUse Textile Recycling: Example of Smart Tag Interface**

Based on the guidelines for consumers and manufacturers, an interface for the Smart Tag was simulated by creating the application ReUse – Textile Recycling, which indicates how manufacturers and consumers should proceed with

their clothing and conduct after use and recycling. For this, the Fabapp® platform was used to create the interface. The initial presentation of the interface is shown equally for manufacturer and consumer, as shown in Figure 3.

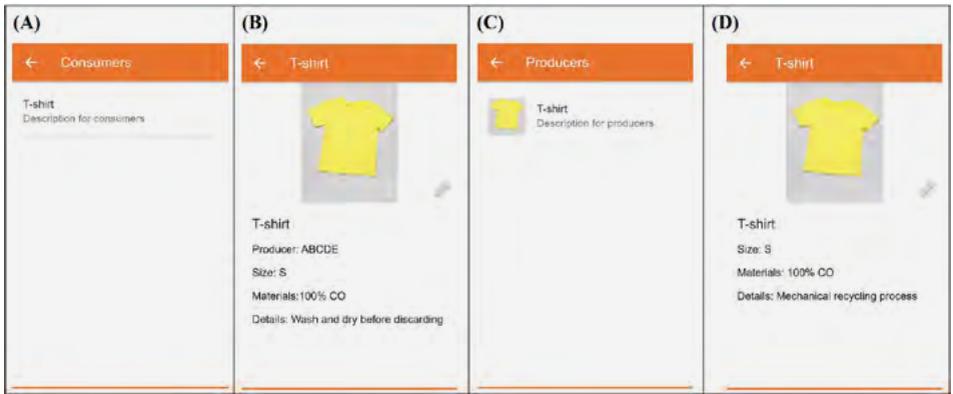


**Figure 3.** *ReUse Textile Recycling*, app home screen for consumer/producer, A. Yumi Sato Duarte, F. Soares De Lima, R. Santiago De Queiroz, R. Aparecida Sanches.

**Figure 4.** *ReUse Textile Recycling*, all app icons that describes each category, A. Yumi Sato Duarte, F. Soares De Lima, R. Santiago De Queiroz, R. Aparecida Sanches.

Figure 4 shows the application icon (A), as well as the icons for consumer (B), manufacturer (C), information on Circular Economy (D) and Textile Industry (E).

When selecting the “Manufacturer” icon (Fig. 5A), there is a description of the discarded part, specifically the fabric and origin of the raw material (Fig. 5B). When selecting the “Consumer” icon (Fig. 5C), there is a description of the part to be discarded and the correct orientation for disposal (Fig. 5D), as shown in Figure 5.



**Figure 5.** *Manufacturer and Consumer screen*, differences between manufacturer and consumer role, A. Yumi Sato Duarte, F. Soares De Lima, R. Santiago De Queiroz, R. Aparecida Sanches.

The QR Code (Figure 6) can be scanned with a smartphone to get access to the ReUse Textile Recycling interface.



**Figure 6.** *ReUse Textile recycling*, QR Code that can be scanned with a smartphone to access the App, A. Yumi Sato Duarte, F. Soares De Lima, R. Santiago De Queiroz, R. Aparecida Sanches.

With the information provided by the application through the smart tag to manufacturers, they will be able to process the material properly, mainly with a focus on the raw material that was used. With the information provided to the user, the user will be able to view data on the article's production process in addition to providing adequate disposal, connecting the consumer with the entire fashion production chain.

## 6. Conclusions

The fashion chain, following the linear model, has a large production capacity and is responsible for the disposal of a significant volume of solid textile waste and other inputs resulting from its production. Part of textile articles are discarded by post-use consumers at textile material collection points, and the other part is discarded directly in the environment, generating numerous negative effects. With the use of the circular economy model, the textile garbage discarded by consumers will be transformed again into textile fibers, to be used in the manufacture of new products, without removing raw materials from nature and with reduced consumption of water, energy and chemicals in the production process.

Having knowledge of the impacts of the processes inherent in the fashion chain, the need for transparency in the production, performance and life cycle of these products becomes important to establish not only policies for the management and reduction of textile waste, but also the interface with the consumer each increasingly aware, demanding and engaged. In this sense, for a greater integration of the chain it is necessary that the information of the processes and components are available, the use of smart tags being a proposal for making the information available, both for consumers and for manufacturers, for guidance in the post-use stages and disposal of textile articles.

## References

- Amaral, M. C. (2016). *Reaproveitamento e Reciclagem Têxtil no Brasil: ações e prospecto de triagem de resíduos para pequenos geradores*. Sao Paulo University.
- Amaral, M. C. D. (2016). *Reaproveitamento e reciclagem têxtil no Brasil: ações e prospecto de triagem de resíduos para pequenos geradores* [Master's Dissertation, Escola de Artes, Ciências e Humanidades], University of São Paulo. doi:10.11606/D.100.2016.tde-11112016-104321. [www.teses.usp.br](http://www.teses.usp.br)
- Avila, A. P. S., Maciel, D. M. H., Silveira, I., & Rech, S. R. (2018). Os Resíduos Têxteis Sólidos no Contexto de Abordagens Sustentáveis: Ciclo de Vida, Economia Circular e Upcycling. *MIX Sustentável*, 4(3), 17-24. <https://doi.org/10.29183/2447-3073.MIX2018.v4.n3.17-24>
- Bauman, Z. (2001). *Modernidade Líquida* (P. Dentzien Trans.). Jorge Zahaz.
- Castells, M. (1999). *A sociedade em rede. A era da informação: Economia, sociedade e cultura* (vol. 1). Paz e Terra.
- Clark, H. (2008). SLOW + FASHION—an Oxymoron—or a Promise for the Future...?. *Fashion Theory*, 12(4), 427-446. <https://doi.org/10.2752/175174108X346922>
- Desouza, K. C., & Smith, K. L. (2014). Big Data for Social Innovation. *Stanford Social Innovation Review*, 39-43. [https://ssir.org/articles/entry/big\\_data\\_for\\_social\\_innovation#](https://ssir.org/articles/entry/big_data_for_social_innovation#)
- Ellen MacArthur Foundation. (2017). *A New Textiles Economy: Redesigning Fashion's Future*. <https://www.ellenmacarthurfoundation.org/assets/downloads/publications/A-New-Textiles-Economy-Full-Report-Updated-1-12-17.pdf>
- Farias, M. M. de. (2016). *Consumo consciente de moda e o metabolismo futuro do guarda-roupa: Uma abordagem quantitativa com mulheres residentes do interior de São Paulo (SP)* [Universidade Presbiteriana Mackenzie]. <https://doi.org/10.13140/RG.2.2.32786.25283>
- Feldhofer, M. (2004). An authentication protocol in a security layer for RFID smart tags. *Proceedings of the Mediterranean Electrotechnical Conference - MELECON*, 2, 759-762. <https://doi.org/10.1109/melcon.2004.1347041>
- Fletcher, K. (2014). *Sustainable Fashion and Textiles* (2nd ed.). Routledge. <https://doi.org/10.4324/9781315857930>

- Fletcher, K., & Grose, L. (2011). *Moda & sustentabilidade: design para mudança*. SENAC.
- Jia, F., Yin, S., Chen, L., & Chen, X. (2020). The circular economy in the textile and apparel industry: A systematic literature review. *Journal of Cleaner Production*, 259, 120728. <https://doi.org/10.1016/j.jclepro.2020.120728>
- Kamrani, A. K. (2008). Collaborative design approach in product design and development. In K. A. K. & E. A. Nasr (Eds.), *Collaborative Engineering: Theory and Practice* (pp. 1-17). Springer US. [https://doi.org/10.1007/978-0-387-47321-5\\_1](https://doi.org/10.1007/978-0-387-47321-5_1)
- Leitão, A. (2015). Economia circular: uma nova filosofia de gestão para o séc. XXI. *Portuguese Journal of Finance, Management and Accounting*, 1(2). <http://u3isjournal.isvouga.pt/index.php/PJFMA/article/view/114>
- Lorenzetti, L. (2018, June 15). *A Importância do Reaproveitamento de Resíduos Têxteis em São Paulo*. <https://www.tratamentodeagua.com.br/artigo/reaproveitamento-residuos-texteis-sp/>
- Mangla, S. K., Luthra, S., Mishra, N., Singh, A., Rana, N. P., Dora, M., & Dwivedi, Y. (2018). Barriers to effective circular supply chain management in a developing country context. *Production Planning and Control*, 29(6), 551-569. <https://doi.org/10.1080/09537287.2018.1449265>
- Pal, K., & Yasar, A. U. H. (2020). Internet of Things and Blockchain Technology in Apparel Manufacturing Supply Chain Data Management. *Procedia Computer Science*, 170, 450-457. <https://doi.org/10.1016/j.procs.2020.03.088>
- Pearce, D. W., & Turner, R. K. (1990). *Economics of Natural Resources and the Environment*. Harvester Wheashealf.
- Roy Choudhury, A. K. (2014). Environmental Impacts of the Textile Industry and Its Assessment Through Life Cycle Assessment. In S. S. Muthu (Ed.), *Roadmap to Sustainable Textiles and Clothing: Environmental and Social Aspects of Textiles and Clothing Supply Chain* (pp. 1-39). Springer. [https://doi.org/10.1007/978-981-287-110-7\\_1](https://doi.org/10.1007/978-981-287-110-7_1)

Slater, K. (2003). Environmental impact of textiles: Production, processes and protection. In *Environmental Impact of Textiles: Production, Processes and Protection*. CRC Press. <https://doi.org/10.1533/9781855738645>

Slater, K. (2008). Environmental impact of polyester and polyamide textiles. In B. L. Deopura, R. Alagirusamy, M. Joshi, & B. Gupta (Eds.), *Polyesters and Polyamides* (pp. 171-199). Woodhead Publishing. <https://doi.org/10.1533/9781845694609.1.171>

Stahel, W. R. (2016, March 24). Circular economy. *Nature - Comment*, 531(7595), 435-438. [https://www.nature.com/news/polopoly\\_fs/1.19594!/menu/main/topColumns/topLeftColumn/pdf/531435a.pdf](https://www.nature.com/news/polopoly_fs/1.19594!/menu/main/topColumns/topLeftColumn/pdf/531435a.pdf)

Tobler-Rohr, M. I. (2011a). *Handbook of sustainable textile production*. Woodhead.

Tobler-Rohr, M. I. (2011b). The supply chain of textiles. In M. I. Tobler-Rohr (Ed.), *Handbook of sustainable textile production* (p. 488). Woodhead.

v

# BIOGRAPHIES

**Ana Margarita Ávila Ochoa**

Industrial Designer specialized in the textile area. Master in History of Urban Art. Full-time Professor and Researcher at Facultad del Hábitat, Universidad Autónoma de San Luis Potosí, and a member of the research group Design & complex thinking, where he develops design research oriented towards Evolution of thoughts, theories and concepts of Design.

[aavilaochoa@fh.uaslp.mx](mailto:aavilaochoa@fh.uaslp.mx)

**Michela Carlomagno**

PhD student in Environment, Design and Innovation at University of Campania Luigi Vanvitelli.

Before she studied Design and Communication at University of Campania Luigi Vanvitelli - Department of Architecture and Industrial Design (DADI) and successively she finished her studies with a Master's degree in Design for Innovation at Department of Civil Engineering Design Construction and Environment (DICDEA) in March 2018.

She is interested in the investigation of innovative approaches to the conceptualization of new vision of design, especially on food design, cosmetic product and communication.

[michela.carlomagno@unicampania.it](mailto:michela.carlomagno@unicampania.it)

**Elisabetta Cianfanelli**

Architect and Industrial Design Specialist, is Full Professor at DIDA (Architecture Department) of University of Florence (Italy), Design Campus section. President of the CdLM in Fashion System Design, and scientific director of the DIDA Lab REI (Reverse Engineering & Interaction Design).

Her research interests are related to the world of Small and Medium Enterprises concerning the development of new products and technologies applied to design and production.

[elisabetta.cianfanelli@unifi.it](mailto:elisabetta.cianfanelli@unifi.it)

**Maria Claudia Coppola**

PhD student in Design at University of Florence, DIDA (Department of Architecture), Design Campus section. Her research combines design approaches, future studies and digital media to foster deeper civic engagement and inclusion. In addition to her studies, she supports Professors at DIDA in managing educational and training activities, communicating with students and tutors.

Outside of the academic environment, she is a designer enjoying philosophy and politics readings from all over the world, with a strong attention to their related languages, be they carved in stone or posted on social media.

[mariaclaudia.coppola@unifi.it](mailto:mariaclaudia.coppola@unifi.it)

**José Luis González Cabrero**

Mexican Industrial Designer, master in Product Design from Politecnico di Milano. He is currently a Design Researcher and Professor at Facultad del Hábitat, Universidad Autónoma de San Luis Potosí, and a member of the research group Design & complex thinking, where he develops design research oriented towards territory & aesthetics.

[info@gonzalezcabrero.com](mailto:info@gonzalezcabrero.com)

**Gina Nadal Fernandez**

Gina Nadal Fernandez is a final year PhD student in the Design Department at Manchester School of Art, Manchester Metropolitan University. Her doctoral research is by practice, and investigates how emotional experience can be designed into digital jacquard woven textiles during a co-design process by using digital coding.

She takes a multidisciplinary approach that embraces design theory, textiles, digital coding, consumer behaviour and mass customisation in her weaving practice using a TC-1 loom and natural yarns.

Gina has presented her research at the PhD by Design workshop at the Design Research Society Conference 2018, at the Global Fashion Conference 2018 and 2020. She is also a member of the Textile Society and Design Research Society. She holds a master's degree in Fashion Graphics from Manchester School of Art, Manchester Metropolitan University that looked at the relationship between digital jacquard textile practice and emotional value using digital coding.

[georgina.nadal-fernandez@stu.mmu.ac.uk](mailto:georgina.nadal-fernandez@stu.mmu.ac.uk)

**Debora Giorgi**

PhD, Architect, she is a Design Researcher at the Dipartimento di Architettura DIDA of the University of Florence. Since 1991 she works on Sustainable Local Development and the social implications of the project starting from the Cultural Heritage. For over 20 years she worked in projects in Ethiopia, Algeria, Tunisia, Morocco, Yemen, Jordan, Haiti, with the most important national and international donors as WHC - UNESCO, UNCCD, European Commission. Since 2011 she has been collaborating with the DIDA UNIFI especially in projects around Maghreb countries and in the social field promoting Social Design projects and workshops using co-design methodologies. She is professor of Service Design at DIDA UNIFI, professor of Design for Cultural Heritage in the License Course in DesignS at Ecole Euro-Méditerranéenne d'Architecture Design et Urbanisme de l'Université Euro-Méditerranéenne de Fès EMADU – UEMF in Morocco and visiting professor in some universities in Mediterranean countries.

[debora.giorgi@unifi.it](mailto:debora.giorgi@unifi.it)

**Beata Hamalwa**

Beata Hamalwa founded Fashion Design Diploma at College of the Arts, Windhoek, Namibia, and Fashion Design Certificate at City Varsity, Cape Town, South Africa, and co-founded the Heroes Primary School - all became imperative in employment creation. Her versatile educational background from Poland, Namibia and South Africa in arts and fashion design has provided a valuable foundation for her career in several art training programmes. She holds a Master of Technology in Design. Her Master's thesis, titled 'Beadwork and its impact on contemporary fashion in South Africa,' investigates the cultural wealth contribution to decolonizing fashion. She believes that modern arts and trends do not imply the demise of indigenous culture. Her latest endeavour is to investigate the possibility of sustainability in the current fashion industry in Namibia, which led me to PhD research at the Cape Peninsula University of Technology. As an artist, Hamalwa has showcased at premier fashion events in Namibia, Portugal, Germany, France, Poland, the United Kingdom, South Africa, Botswana, and Reunion Island.

[beatkash@yahoo.com](mailto:beatkash@yahoo.com)

**Francesco Izzo**

Full Professor of Strategic Management of Innovation at the University of Campania Luigi Vanvitelli, where he teaches also Strategic Analysis. He has been Dean of Department of Economics from 2017 to 2020. He is member of the Entrepreneurship and Innovation Ph. D. teaching board. He has been visiting professor of Innovation Management at the University of Naples Federico II. His research interests include innovation strategy, international strategy of SMEs, innovation in creative industry, cultural entrepreneurship. He is author of a large number of scholarly publications on these topics. He is member of Valuation Committee of University L'Orientale. He has been head of Valuation Committee of the Stazione Zoologica Anton Dohrn, a public research organization in the fields of marine biology and ecology, from 2010 to 2016. He served as a consultant to Ministry of Innovation, collaborating at programs about regional innovation systems, academic spin-off and venture capital, and member of the Steering Committee of Council of Ministers for the program High-Tech for Southern Italy.

[francesco.izzo@unicampania.it](mailto:francesco.izzo@unicampania.it)

**Regina Aparecida Sanches**

Degree in Textile Engineering at University Center of FEI (1987), Master in Mechanical Engineering at State University of Campinas (2001), Ph.D in Mechanical Engineering at State University of Campinas (2006) and Postdoctorate in Design at University of Lisbon (2016).

She started her academic career in 1995, was the coordinator of the undergraduation course in Textile Engineering at University Center of FEI (2001 to 2006), was the coordinator of the undergraduation course in Textile and Fashion at University of Sao Paulo (2010 to 2012), was the coordinator of the Master's Degree in Textile and Fashion at University of Sao Paulo (2012 to 2016).

She has been a professor at the School of Arts, Sciences and Humanities since 2006 and has been an associate professor at the University of São Paulo since 2011. She researches in the areas of textile materials, knitting technology and textile design.

[regina.sanches@usp.br](mailto:regina.sanches@usp.br)

**Rayana Santiago de Queiroz**

PhD student in the Textile Engineering course at the University of Minho (Portugal), master (2013) and graduated (2009) by the Textile and Fashion course at the University of São Paulo.

Since 2012 acts as a researcher at the Technical Textiles and Protection Products Laboratory of the Institute for Technological Research, where has been working especially on the following topics: vegetable textile fibers, natural dyes, comfort, characterization and performance evaluation of technical textiles.

[rayanasq@ipt.br](mailto:rayanasq@ipt.br)

**Adriana Yumi Sato Duarte**

Undergraduate (2009) in Bachelor of Textiles and Fashion from the University of São Paulo, Master (2013) and PhD (2017) in Mechanical Engineering from the State University of Campinas (Unicamp). Conducted a period of Internship of Doctorate Sandwich Abroad (SWE) - Science without Borders Program (2015-2016) at Fachgebiet Datenverarbeitung in der Konstruktion (Dik), Technical University of Darmstadt, Germany.

She has experience in Mechanical Engineering with an emphasis on Mechanical Design and in Textiles and Fashion with an emphasis on product design methodology, sustainable product development, Brazilian natural fibers, knitting technology and Industry 4.0. She is currently Assistant Professor II at Nossa Senhora do Patrocinio University and Coordinator of the Fashion Design Course.

[adriana.duarte@ceunsp.edu.br](mailto:adriana.duarte@ceunsp.edu.br)

**Chiara Scarpitti**

Chiara Scarpitti, designer and PhD, is Researcher at the Department of Architecture and Industrial Design of the University of Campania "Luigi Vanvitelli". Since 2006 she has been working in the field of design and jewellery at an international level, obtaining numerous awards and exhibiting her works in museums and galleries including Triennale Design Museum in Milan, MAD Museum of Art and Design in New York and HOW Design Center in Shanghai.

Member of the Board of Directors of AGC - Association for Contemporary Jewellery, she taught jewellery design at IED Moda in Milan and at the Academy of Fine Arts in Naples.

In 2018 she has published the monograph "Multipli Singolari. Contemporary jewellery beyond digital" with ListLab, Barcellona, in double edition (ita/eng), and in 2020 "Oggetti pensiero. Storie di design, organismi e nature plurali" with Lettera Ventidue, Siracusa. Her theoretical research is characterized by a speculative hybridization between digital technologies and manufacturing excellence linked to contemporary design and fashion.

[chiara.scarpitti@unicampania.it](mailto:chiara.scarpitti@unicampania.it)

**Fernando Soares de Lima**

Degree in chemistry from the University of Mogi das Cruzes (2004), Master in Industrial Processes from the Technological Research Institute of the State of São Paulo (2013) and Chemical Production Engineer from Faculdades Oswaldo Cruz (2017). He is currently responsible for the Technical Textiles and Protective Products Laboratory and for the Shoes and Protective Products Laboratory of the Technological Research Institute of the State of São Paulo.

He mainly works on the following topics: technical fabrics, characterization tests and performance evaluation of textiles and PPE's, weathering and microencapsulation applied to textiles.

[nandosl@ipt.br](mailto:nandosl@ipt.br)

**Renato Stasi**

Renato Stasi has been involved in the creation of clothing and accessories collections for the fashion segment for almost thirty years, as a designer and responsible for the development of the collection, he has worked for several companies including the LVMH Group, Redwall, Hettabretz. He is an adjunct professor at the DIDA - UNIFI Department of Architecture, in the CDL in Industrial Design and CDLM Fashion System Design. Lecturer at IED, where he is the coordinator of two three-year courses. He has carried out supplementary teaching activities at the Politecnico di Milano for several years.

He has held seminars and workshops in various universities. Stasi is Coordinator of the Steering Committee of the Master's Degree Course in Fashion System Design of the University of Florence - School of Architecture - DIDA.

[renato.stasi@unifi.it](mailto:renato.stasi@unifi.it)

**Margherita Tufarelli**

Designer, PhD in Design. Currently a research fellow at DIDA (Department of Architecture) of the University of Florence (Italy), Design Campus section. The PhD thesis, with the title "future heritage and heritage futures. An exploration on meanings of the digitized Cultural Heritage" aimed at investigating the role that the digital archives of Cultural Heritage can have in the contamination between the culture of the past and contemporary creativity. Her research interests concern the heritage/creativity sphere within the digital evolution; thus, the application, impact and opportunities that lie in the relationship between digital technologies and cultural heritage. She is currently working on a research project titled "Living archive. Disseminating and reusing the Fashion cultural heritage" founded by Regione Toscana.

[margherita.tufarelli@unifi.it](mailto:margherita.tufarelli@unifi.it)

**Rosanna Veneziano**

Architect, Ph.D. in Industrial, Environmental and Urban Design, Assistant Professor of Industrial Design at the University of Campania Luigi Vanvitelli - Department of Architecture and Industrial Design (DADI). Since 2002 she carries out an research activity on design oriented strategies for the local production development.

Since 2008 she coordinates (with P. Ranzo e M.A. Sbordone) the Design for Peace Lab activities. The creative lab was established following the draft agreement signed by the Province of Naples - Councilorship to Peace and International Cooperation - and the Department with the purpose of sharing experiences and best practices in the field of international cooperation and the management of humanitarian emergencies.

She teaches from 2013 to now Social Design and Design for Cosmetic - Design for Innovation Degree Course at University of Campania 'Luigi Vanvitelli'.

[rosanna.veneziano@unicampania.it](mailto:rosanna.veneziano@unicampania.it)



AIAP CDPG, the Graphic Design Documentation Centre. Working to collect, catalogue, archive, enhance and promote any documents related to graphic design and visual communication. These documents (originals as well as layouts of projects, books, posters, prints, catalogues, correspondence, photographs) help to rewrite the history of graphic design in Italy and to support research and educational activities, as it is the CDGP's intention to make these documents widely available.



**A HEART  
BEATS  
WITHIN  
AIAP.  
FIND IT OUT.**



**AIAP CDPG**  
centro di documentazione  
sul progetto grafico

AIAP  
via A. Ponchielli, 3  
Milano  
aiap.it – @Aiap\_ita



**PAD. Pages on a and Design**

International, peer-reviewed,  
open access journal  
ISSN 1972-7887

#22, Vol. 15, June 2022

[www.padjournal.net](http://www.padjournal.net)



**AIAP**

associazione italiana design  
della comunicazione visiva