

FOSTERING TRANSITION TO INDUSTRY 5.0 FOR HANDCRAFT FASHION SMEs: THE CASE OF FUTURE FASHION MADE TO ORDER SUITE

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Abstract. *Industry 5.0 implements innovative processes to bring the human touch back to manufacturing and enhance customer satisfaction. An Industry 5.0 driver is growing demand for more personalized products and services. This paper studies the potential to adopt mass personalization as an e-commerce strategy for small-medium enterprises (SMEs) in the handcraft sector to move towards Industry 5.0. The handcraft sector can produce highly personalized products, and represents culture and tradition of the territory but have limited resources compared to industry manufacturers. Consequently, adoption of Industry 5.0 initiatives deserves special scrutiny. More specifically this paper analyses a specific Make To Order suite and online sales configurator implemented for the e-commerce of a SME selling personalized men's shoes handcrafted in Italy, namely Design Italian Shoes.*

The considered suite is designed by Future Fashion (FF), as mass personalization strategy provider of software application solutions designed to implement e-commerce in the fashion sector, such as, virtual retail, 3D product configurators, and product representation in augmented reality. Thanks to FF software solutions and its 3D management asset the e-commerce of the considered SME is enhanced with a network of "digital handcrafters" co-creating and delivering each order worldwide within 10 days. Managerial implications from the present study advise that the implementation of the analyzed suite can be determinant in fostering digital transition for SMEs from handcraft sector while enhancing the sustainability of their strategy with digital technology. The reported case study contributes to ongoing debate on whether the adoption of online sales configurators can favor SMEs embracing the Industry 5.0.

Key Words: *Mass Personalization, Industry 5.0, Online Sales Configurator, Made to Order Suite, Digital Craftsmanship*

1. INTRODUCTION

Research on Industry 5.0 [1-6] describes it as the movement to (i) bring the human touch back to the manufacturing industry and (ii) enhance customer satisfaction [4]. The term "Industry 5.0" was coined to address personalized manufacturing and empower human beings in manufacturing processes [1]. An additional consumer's desire for mass personalization has been indicated as a cultural driver of Industry 5.0.

As a result, manufacturers are replanning their business to implement digital technology that can favor more human-centric supply chain processes and more customer-oriented strategies to provide their customers with personalized offerings. Implementing such strategies requires structural transformations at the organizational level. However, implementing a mass personalization strategy, as in the extreme case of mass customization [7], is not without criticism since it requires planning the supply chain, distribution logistics, and reshaping the processes of design, production, and relationship with customers [8].

A successful replanning strategy in terms of mass personalization requires connecting these processes to technology applications designed to completely fulfill each customer requirement, such as in a made to order suite (MTO). MTO, in the context of the present paper, refers to a digital platform implemented with technology applications to manage the whole mass personalization strategy.

The choice of the right technology to support the implementation of a mass personalization strategy is crucial, especially for those companies with limited resources to invest in technology innovation likewise small- and medium-sized enterprises (SMEs) [9-11]. As an example, SMEs that aim to follow the Industry 5.0 movement may need technology applications that are easy to implement and manage in order to implement mass personalization strategies and overcome limitations in terms of marketing or information, communication and technology (ICT) competences and resources available internally.

This paper aims to contribute to research on mass personalization strategy in the looming Industry 5.0 movement. To this end, it addresses Industry 5.0 aims by studying the potential to adopt mass personalization as an e-commerce strategy for SMEs to bring the human touch back to manufacturing and enhance customer satisfaction. Empirically, this study focuses on the MTO suite (as a digital technology) designed by Future Fashion Solution, a start-up that designs digital technology solutions to support companies in the fashion sector selling personalized products globally. Future Fashion Solution (for shortness FF) provides mass personalization strategy and software application solutions designed to implement e-commerce for fashion companies, with the made to order personalized suite, 3D asset management, virtual retailing, and 3D online sales configurators (OSCs). Online product configurators are known in the literature on mass customization as web-based user interfaces that allow potential customers to personalize a product by choosing from a company's product offerings [12-15]

This study analyzes the MTO suite designed by FF and implemented by the company Design Italian Shoes (DIS), with a focus on the online sales configurator as an e-commerce tool of the suite. DIS is an Italian SME that sells personalized men's shoes handcrafted by artisans from the district area named "Shoes Valley" in le Marche region, Italy. Handcrafted products play a key role in terms of cultural value and distinctiveness in every national economy and are a sector that can produce manufactured goods with high levels of personalization and have limited resources compared to industrial manufacturers [16, 17].

The DIS configurator represents a remarkable case to underline the contribution of the FF MTO suite in supporting SME selling globally handcrafted Made in Italy offerings. To achieve this goal, FF designed an MTO suite that enables DIS to implement an online sales configurator as a business to customer to business model (B2C2B). Following Industry 5.0 aims, with reference to implementing more customer-oriented processes, the present study detects which (if any) benefit customers could derive by shopping on configurators implemented with FF applications and the. With reference to the aim of bringing the human touch back to manufacturing, the study explores the key factors at technological, environmental, and social levels that make (or not) the FF MTO a technology appropriate for handcrafting.

In particular for SMEs in handcraft fashion seeking to take advantage of the adoption of online sales configurators in accordance with the Industry 5.0 movement. The paper is structured as follows: section 2 provides the theoretical background; section 3 describes the methods used to analyze the case study; and section 4 proposes the case of FF MTO suites to underline challenges for SMEs in implementing the suite. Section 5 concludes.

2. THEORETICAL BACKGROUND

2.1. The cultural driver behind Industry 5.0

Although Industry 4.0 is not yet well grown, many industry pioneers and technology leaders are looking ahead to Industry 5.0. The Fifth Industrial Revolution will pair people and machines to make greater use of the power and creativity of people in order to increase the efficiency of work processes with the support of intelligent systems [6].

Industry 5.0, in the context of enterprise management, innovation, and digitization, refers to making innovation more understandable, implementable, and part of the routine in organizations requiring product innovation through design thinking [1]. A core need for moving toward the notion of Industry 5.0 in organizations is the identification of how digital product and process innovations might affect profitable customer strategies in a global context [18]. As reported in Maddikunta [4],

Industry 5.0 is primarily designed to enhance customer satisfaction. Any innovative processes in Industry 5.0 must be connected to technology solutions designed for customer and sales management aimed at being more efficient and customer-oriented. In research on manufacturing innovation, the term Industry 5.0 refers to personalized manufacturing and empowering human beings in manufacturing processes.

Based on the literature [1-6], Industry 5.0 is the movement to bring the human touch back to the manufacturing industry and to enhance customer satisfaction. An interesting quotation could summarize the connection between these two facets of the Industry 5.0 movement: *When customers want to express their identity through the products they buy they crave the personal imprint of human designers and craftspeople, who produce something special and unique through their personal effort. (...) This desire for mass personalization forms the psychological and cultural driver behind Industry 5.0 – which involves using technology to return human value to manufacturing* (Esben H. Østergaard, founder and CTO of Universal Robots).

2.2 Mass personalization in Industry 5.0 movement

The sale of customizable products is defined in the literature as a mass customization strategy [19] based on "developing, producing, marketing and delivering affordable goods and services with enough variety and customization that nearly everyone finds exactly what they want" [20]. In the context of the Industry 5.0 movement, mass customization plays a key role in gathering innovation technology processes to bring the human touch to manufacturing while fulfilling each customer's idiosyncratic needs [1, 21].

As stated in previous research [22], branding products no longer guarantees loyal customers because tried-and-true marketing techniques from the past no longer work for most products—particularly for complex ones based on new technologies. Companies that implement mass customization could increase customer loyalty by improving the fit between the self-designed product and

individual preferences and pushing customers to change brands if another company offers a similar product in terms of price and quality, which also allows one to personalize the product.

Mass personalization is the advanced stage of mass customization since it addresses a market of one, the extreme case of mass customization [7]. In 2015, a study by Deloitte (2015) on the rise of mass personalization highlighted that the future of customer engagement lies in a business model that will implement mass personalization providing tailored products, as the demand for personalized products will continue to increase. In some categories, up to 50% of customers express interest in purchasing personalized products or services. Moreover, most consumers would also be willing to pay a premium price, particularly in the more expensive or fashion-related categories.

An additional benefit of the mass personalization strategy within the Industry 5.0 revolution is the reduction of warehousing and over-production costs and waste generation [2]. The following prophetic quotation could summarize the relevance of the mass personalization strategy: *“In the future businesses that embrace personalization have the opportunity to create a differentiated proposition that may command a price premium and improve consumer traffic and conversion. The challenge is to determine how many options are necessary for a product and or a service to feel unique while still profitable”* (Deloitte, 2015).

2.3 Online sales configurators to sell personalized offerings

The implementation of mass customization and product personalization strategies requires companies to rethink their strategies and implement the proper technology solution in the processes of design, production, and relationship with customers [12-15]. The online product personalization strategy is increasingly widespread, especially via online sales configurators (OSCs), that is, knowledge-based software applications that support potential customers, as they can choose from a company's product offerings the product solutions that best suit their needs [23-25].

OSC software can be designed to support the sales force in guiding customers toward solutions that fulfill their personal requirements. For customers, searching online among thousands of possibilities for a solution that coincides with their needs can be overwhelming. The capabilities of an OSC help in responding to customer care, as the OSC allows for the support of potential customers in their decision-making processes, for example, by reducing choice complexity (the amount of information processing necessary to make a decision) [24]. Likewise, it is acknowledged in the literature that product configurators can support consumers in identifying their own solutions while reducing computational and non-computational sources of decision difficulty [26, 27]

From the companies' perspective, an OSC also helps improve the quality and speed of their offerings and delivery to customers by reducing costs (e.g., stock costs and unsold products), as well as by mitigating the negative

effects of product customization on cost, time, and quality of performance.

As was stated in a previous studies, Italian SMEs could benefit from these strategies [9-11] and may overcome their limits in terms of competences and resources available internally, specifically in the domains of marketing or ICT.

3. METHODS

The present study discovered the MTO suite designed by FF as a case to detect best practices for selling handcrafted offerings via an online sales configurator. The case of FF was chosen because of its relevance in accordance with the dynamics of Industry 5.0, since it gathers technology solutions for product personalization, thus bringing back the human touch of craftspeople. Empirically, we studied FF MTO implementation of e-commerce by DIS, an Italian SME from the Made in Italy group selling handcrafted men's shoes.

We adopted quali-quantitative methods, such as structured interviews and desk research, to explore the case step-by step. In the first step, we reported the key issues in terms of market positioning that FF considered when designing the MTO suite for DIS. Subsequently, we recompiled the elements that FF evaluated for design technology solutions that responded to DIS business goals and supported its business model innovation.

In the second step, we analyzed the online sales configurator, the customer interface of the MTO suite. The analysis of the DIS configurator included a study of the benefits customers (or potential ones) could experience by shopping on it. The study of the OSC followed the methodology adopted in previous studies on mass customization with OSCs [28-30]. A researcher with strong expertise in configurator capabilities collected the data, while the interpretation was conducted through a collaborative endeavor with the authors.

The conclusive step of the case study focused on technological, environmental, and social factors to broaden understanding of the impact that the FF MTO suite can provide to SMEs.

4. FUTURE FASHION MADE TO ORDER SUITE

To explore capitalizing from the potential to implement FF solutions for a mass personalization strategy, we collected qualitative information from a structured interview with Dr. Andrea Carpineti, CEO and co-founder of FF. Dr. Carpineti, who holds a PhD in economics, described in a very detailed and technical manner the FF MTO suite. In the following, we first describe the solutions that the FF suite provides to companies in the fashion sector. Second, we focus on the FF MTO suite implemented by DIS, an Italian SME that operates in the fashion industry producing men's footwear.

4.1 Future Fashion digital applications for fashion industry

As described by Dr. Carpineti, FF is a start-up with a mission to innovate e-commerce environments with digital applications to sell personalized offering and/or create

highly engaging customer experiences with 3D applications. FF has a team of 3D artists and web developers designing 3D technologies and optimizing their implementation into web platforms. FF technology applications include the MTO suite, 3D configurator, 3D asset management, and virtual store. In the present paper, we focus on the MTO suite.

4.1.1 Made to order suite

The MTO suite is a multichannel digital platform in which it is possible to manage the whole mass personalization strategy and its processes (i.e., from order and purchase by the customer to the production line and to product delivery). The MTO designed by FF is an integrated web-based platform implemented with digital applications such as product visualization in 3D and augmented reality (AR) omnichannel sales, up to production. The suite has a 3D configurator as an end-user tool to support customers in creating their own customized product. Once the order is placed via the online sales configurator, it is put into real-time production through a transcoding system integrated with any Enterprise Resource Planning software (ERP).

From a customer experience perspective, the configuration experience via the OSC designed by FF is enhanced with product viewers integrated with AR to enable highly realistic visualization of each product solution self-designed by customers. For example, a customer can visualize a virtual representation of his/her configured product; in the case of shoes, s/he can have a virtual preview of how they fit (Fig. 1¹).

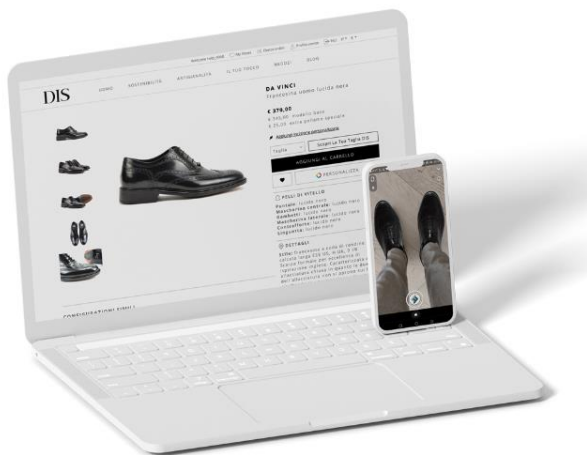


Fig. 1. Product virtual representation in augmented reality

All FF applications are compatible with almost all ERP and e-commerce applications (to cite a few: Magento, API, Bigcommerce, Etsy, Shopify, OracleNet suite).

In 2017, the MTO suite designed by FF was implemented to support DIS. This represented the very first instance of technology developed in a real case of mass personalization e-commerce, as described in the following.

4.2 Future Fashion MTO suite for handcrafted offerings

How did it start, the challenge to develop technology applications for selling handcrafted footwear? Answering the question, Dr. Carpineti explained: *“In recent years, the world footwear market has undergone a profound transformation process determined by an evolution in consumer purchasing behavior on a global level and by a change in competitive dynamics. New markets were opening up, but not all Italian SMEs were ready to face an internationalization process of their e-commerce. In 2018, the customized footwear market reached a turnover of 68 billion dollars and will reach 92 billion dollars in 2024. This growing trend is driven mostly by Asian markets. Italy is the second country in the world in the footwear industry, with an export volume of 211.1 million pairs of shoes for a turnover of 9.2 billion euros in 2017. At the time that Future Fashion developed the technology solution for DIS, it was estimated that Italy’s sales potential in new markets in 2018 would reach 1.9 billion euros, 51% more than the estimated levels in 2012. The segment of footwear with upper in leather/hide (DIS segment) generated in 2017 an export volume of approximately 6.6 billion euros, for a total of over 131 million euros. These were robust and promising weapons to start our adventure with a real case of mass personalization selling strategy”.*

Since 2017, the Future Fashion technology solutions have support DIS in selling in Italy and 35 other countries, with 90% of its income derived from selling personalized products via OSCs. At present, DIS offers the fastest 100% Made in Italy customized men’s shoe service in the world, due to the MTO suite designed by FF. The MTO provides potential customers with multichannel applications to access product configurators with different devices (Fig. 2), including digital corners placed into retails that sell the DIS brand.

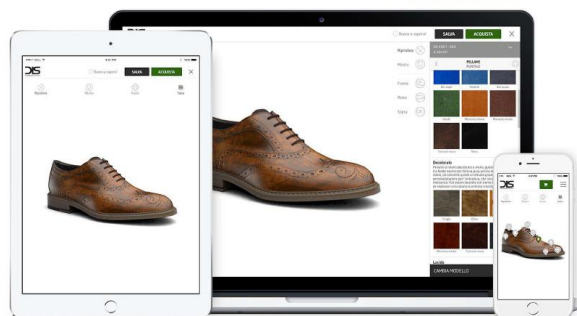


Fig. 2. Multichannel access to online sales configurator

The digital corner allows customers to configure and order personalized shoes directly in the retail through a touch screen totem implemented with a 3D scanner to measure their foot size (Fig. 3).

¹ All pictures in the present paper are under copyrights of Future Fashion Solution, any reproduction is allowed



Fig. 3. In retail online sales configurator with size scanner

4.2.1 Digital craftsmanship supported by Future Fashion MTO suite

The implementation of FF MTO enabled DIS to develop a specific business model in terms of mass personalization that is B2C2B, as an intersection business model that combines business to customers (B2C) and business to business (B2B).

To further explore which aspects were determinant for FF to be able to use a MTO suite to respond to the business goal of DIS, Dr. Carpineti described the scenario he and his co-founder looked at to come up with proper technology solutions. The scenario included a large number of artisan shops specialized in specific shoe models concentrated in distant geographic areas, making it difficult for a customer to find in a single area or store one or more products that meet their wants or needs. Thus, the potential variety of handcrafted men's shoes actually offered was geographically disseminated.

FF aimed at developing an MTO suite able to convert the disadvantages of geographical dispersion into a suitable business model for DIS and artisans in the district (i.e., "Shoes Valley"). FF MTO suites enable processes that are supported by digital interfaces that connect front and back ends to enable real-time interactions, which drove the traditional craftsmanship of shoes into the digital era.

The FF MTO reconfigured the core business to implement a production system that connected artisans in a digitized network for the production of customizable shoes. We consider such a network a "digital handcraft network" that is not limited to digital technology adoption to connect DIS motherhouses with handcraft workers as providers but involves creating sustainable development strategies from local resources to global selling opportunities (Fig. 4).

The enabling of a B2C2B model was possible because

mass personalization processes have been implemented in the entire industry process by decentralizing the supply chain in a backend structured with a network of artisans in the Marche shoe-manufacturing district. Thanks to the adoption of digital interfaces designed by FF, each artisan unit is informed by the digital interface, through which s/he can also communicate in real time to update and monitor the entire process—from the order being placed until its delivery. The digitization of the entire process of product personalization facilitates one of the key factors in successful mass production: delivery time. Thus, DIS is able to deliver all over the world with guaranteed delivery within 10 working days from the issue of the order (Fig. 4).



Fig. 4. Process of handcrafted men's shoe production and steps of mass customization strategy supported by FF MTO

4.3 Customer experience via the Design Italian Shoes configurator

As was mentioned in the previous section, the MTO suite is implemented with a 3D configurator. In the following, we explore the main characteristics of the DIS configurator in terms of the customer experience.

From a customer experience point of view, online co-design enables a product configurator to be accessible from the company's website. The configurator is translated into six languages to allow customers from various countries to place orders in their preferred language, while the interface automatically translates the order into Italian in the backend.

The digitalization of this technology aids in preventing communication problems between customers and the artisans and sub-suppliers of components (e.g., leather, soles) who receive orders and work on them up to fulfillment within the scheduled time. During the production process, all the actors involved can interact in real time to update the state of the order, and end users are continually updated on the progress of their personalized products.

4.3.1 Customer perceivable benefits

The implementation of the DIS configurator is aimed at offering the customer significant benefits in addition to the utilitarian benefit derived from the closeness of fit between objective product characteristics (i.e., physical, aesthetic,

functional characteristics) and individual preferences regarding a product's functional and/or instrumental characteristics (29). Due to its specificity, the DIS configurator provides users with a product space that contains a variety of options and attributes enabling users to self-design a product with the feeling of creating something personal and unique. The DIS configurator guides end users to a final product personalization that can deliver a high level of uniqueness and self-expressiveness, creative achievement and hedonic benefits² compared to a configurator with a limited product space offering and a limited number of personalizable components. Specifically, the benefits that a customer can derive from the possession of DIS personalized footwear include the high level of uniqueness that a consumer derives from the opportunity to assert their personal attributes by possessing a personalized product and a high level of self-expressiveness that originates from the opportunity to possess a product that reflects the self (30).

Due to the opportunity to personalize all components of the shoes, the DIS configurator engages end users in a configuration experience able to arouse high levels of pride in authorship, including the feeling experienced by individuals of being the creator of an artifact (creative achievement).

4.3.2 Product visualizations

The configuration process's realistic 3D visual representation of the desired product and real-time visualization of each change users make can engage users in an enjoyable shopping experience (hedonic benefit). Hedonic benefit derives from the capacity of the mass personalization experience to be intrinsically rewarding for potential customers.

In contrast to configurators that enable flat product representation (2D) and those that do not make user choices and changes visible in real time nor provide a final representation of the configured products, the DIS configurator provides a high level of both creative achievement and hedonic benefit. Both these latter benefits are part of the configuration process itself and thus may be experienced even if a potential customer does not take advantage of the opportunity; this leaves users with a rewarding feeling.

4.4 Findings on challenges for SMEs to implement FF MTO suite

4.4.1 Obstacles to be overcome

As confirmed by Dr. Carpineti, the implementation of the MTO suite has not gone without criticism. There are indeed several obstacles, especially in regard to the digitalization of craftsmanship activities. Main obstacles relate to the lack of transcoding of communications concerning orders, the lack of real-time communication between backend actors, the lack of a shared same individual language between the frontend and backend, and the lack of customer care capable of following each customer in real time from the beginning to the closing of the sale. Among these challenges, the greatest was the gap between local artisans' business vision and DIS's founder

vision. Several were cultural barriers that the co-founders faced in communicating the advantages of participating in a long-tail business model for local artisans. For the craftspeople, rethinking their production and sales processes aroused skepticism and distrust.

4.4.2 Opportunities for SMEs

The pandemic has also caused a drastic drop in sales in the fashion sector due to the decline of all activities related to socializing and fashion. The implementation of mass personalization networking allows artisans to minimize unsold goods and avoid having to invest and receive payments in advance from DIS. It also allows local production systems to survive the economic side effects of the pandemic. Moreover, FFS MTO has provided a sustainable way for companies that implemented it to convert critical consequences of the pandemic into opportunities, as production generates CO₂ emissions savings of at least 30% compared to seasonal production, and unsold items are cleared at the end of the season.

The implementation of FF's MTO has enabled the activation of a sustainable model of re-evaluation and interconnection for craft activities through digital interfaces. As a result, SMEs can benefit from the intersection between local handcraft production and internationalization through digital technology solutions designed by FF.

The digital innovation experienced by the SME DIS is the result of a successful implementation of a mass personalization strategy with proper digital technology. In this specific case, innovation processes involved a large part of the district in which the company operates and implementing the networking of digital artisanship of leather shoes that represent the excellence of Made in Italy.

5. CONCLUSION

This paper studied the case of a mass personalization strategy via an online sales configurator enabled by an MTO suite programed by FF. The start-up designs software applications to enhance the e-commerce strategy of companies in the fashion sector that aim at selling personalized offerings and/or enhancing the customer experience.

The case study contributes to ongoing debate on the extent to which the adoption of made to order selling strategies via online sales configurators can support companies' e-commerce applications while taking advantage of a sustainable transition to the Smart Industry 5.0 movement.

Following Industry 5.0 aims, with reference to implementing more customer-oriented processes, the study detected the functionalities deployed by a OSC implemented with FF applications and introduce to the benefits customers could derived. With reference to the aim of bringing the human touch back to manufacturing, the study explored key factors at technological, environmental, and social levels that make (or do not) the FF MTO a technology to support SMEs in their e-commerce of personalized offerings. Based on findings from the case study presented, SMEs that sell handcraft fashion products can take advantage of the adoption of a

MTO suite designed by FF. In detail, the advantages primarily refer to opportunities in sustainable manufacturing processes and innovation based on business networks as distributed knowledge systems. Other advantages refer to the possibility of transforming SME e-commerce strategies into sustainable business strategies.

In Zeng et al. The term industrial sustainability have being defined as development that meets the needs of economic growth, social development, environmental protection and results in industrial advantage for the short and the long-term future of the region [32]. The MTO suite enables SMEs to act in a sustainable way in terms of economic need, social development, and environmental care, creating benefits for the region. SMEs committed to sustainability and digital transition can adopt FF's MTO to develop services and products with a technological orientation to construct systems enabling interaction with consumers and stakeholders. The adoption of the FF MTO suite can contribute to business model innovation and impact regional sustainable development.

The present study contributes to ongoing debate on whether the adoption of a mass customization strategy can favor SMEs adapting to the Smart Industry 5.0 paradigm. Designed OSCs for the selling of personalized handcraft offerings give handcraft relevance and distinctiveness for any national economy. Moreover, the operational capability of mass personalization enables configured products to fulfil customers' idiosyncratic need by countering a product's possible liability of foreignness, which also increases the perceived product quality in export markets.[31]

The originality of the study relies on its contributions in terms of managerial insights into the potential to adopt FF applications implementing SME e-commerce with mass personalization strategy and technology that can drive SMEs toward Industry 5.0 movement.

Further research will extend the study to the implementation of FF solutions into different fashion product categories with attention to its impact on sustainable strategies. In particular, a further step of the present study will address the sustainability of Future Fashion mass personalization solutions in terms of waste saving and pollution mitigation. The issues deserve a scrutiny since the 15% of the fabric used by the fashion industry, at global level, is wasted, which this is just one of the many ways that fashion industry negatively affects the environment. Further, the present study will address the emerging of professional figures required to manage digital technologies designed to implement e-commerce with mass personalization strategies. In particular, a next step of the present study will focus on Future Fashion 3d management assets and the skills required to manage it.

7. REFERENCES

- [1] Akundi, A., Euresti, D., Luna, S., Ankobiah, W., Lopes, A. and Edinbarough, I. (2022), "State of Industry 5.0—Analysis and Identification of Current Research Trends", *Applied System Innovation*, Vol. 5, No. 1, pp. 27.
- [2]Fazal, N., Haleem, A., Bahl, S., Javaid, M. and Nandan, D. (2022), "Digital Management Systems in Manufacturing Using Industry 5.0 Technologies", in, *Advancement in Materials, Manufacturing and Energy Engineering*, Vol. II, Springer, pp. 221-234.
- [3] Javaid, M. and Haleem, A. (2020), "Critical components of Industry 5.0 towards a successful adoption in the field of manufacturing", *Journal of Industrial Integration and Management*, Vol. 5, No. 03, pp. 327-348.
- [4] Maddikunta, P.K.R., Pham, Q.-V., Prabadevi, B., Deepa, N., Dev, K., Gadekallu, T.R., Ruby, R. and Liyanage, M. (2022), "Industry 5.0: A survey on enabling technologies and potential applications", *Journal of Industrial Information Integration*, Vol. 26, No. pp. 100257.
- [5] Majerník, M., Daneshjo, N., Malega, P., Drábik, P. and Barilová, B. (2022), "Sustainable Development of the Intelligent Industry from Industry 4.0 to Industry 5.0", *Advances in Science and Technology Research Journal*, Vol. 16, No. 2, pp. 12-18.
- [6] Nahavandi, S. (2019), "Industry 5.0—A human-centric solution", *Sustainability*, Vol. 11, No. 16, pp. 4371.
- [7] Wang, Y., Ma, H.-S., Yang, J.-H. and Wang, K.-S. (2017), "Industry 4.0: a way from mass customization to mass personalization production", *Advances in Manufacturing*, Vol. 5, No. 4, pp. 311-320.
- [8] Tiihonen, J. and Felfernig, A. (2017), "An introduction to personalization and mass customization", *Journal of Intelligent Information Systems*, Vol. 49, No. 1, pp. 1-7.
- [9] Suzic, S., Sandrin, E., Suzic, N., Forza, C. and Trentin, A. (2020), "Product Configuration Activities in SMEs and their Digitalization: Preliminary Results of a Survey Study", in: L.H. C.Forza, and A.Felfernig (Ed.), *Proceedings of the 22nd International Configuration Workshop*, University of Padua, Italy, Conference, pp. 106.
- [10] Suzić, N., Sandrin, E., Suzić, S., Forza, C., Trentin, A. and Anišić, Z. (2018), "Implementation guidelines for mass customization: A researcher-oriented view", *Int. J. Ind. Eng. Manag.*, Vol. 9, No. 4, pp. 229-243.
- [11] Suzić, N., Forza, C., Trentin, A. and Anišić, Z. (2018), "Implementation guidelines for mass customization: current characteristics and suggestions for improvement", *Production Planning & Control*, Vol. 29, No. 10, pp. 856-871.
- [12] Haag, A. (1998), "Sales configuration in business processes", *IEEE Intelligent Systems and their Applications*, Vol. 13, No. 4, pp. 78-85.
- [13] Forza, C. and Salvador, F. (2008), "Application support to product variety management", *International Journal of Production Research*, Vol. 46, No. 3, pp. 817-836.
- [14] Forza, C. and Salvador, F. (2003), *Configurazione di prodotto*, McGraw-Hill.
- [15] Hvam, L., Pape, S. and Nielsen, M.K. (2006), "Improving the quotation process with product configuration", *Computers in Industry*, Vol. 57, No. 7, pp. 607-621.
- [16] Bettiol, M., Di Maria, E. and Capestro, M. (2018), "Una via italiana all'Industria 4.0?", *Quaderni di ricerca sull'artigianato*, Vol. 6, No. 1, pp. 103-120.

- [17] Micelli, S. (2011), *Futuro artigiano: l'innovazione nelle mani degli italiani*, Marsilio Editori Spa.
- [18] Aslam, F., Aimin, W., Li, M. and Ur Rehman, K. (2020), "Innovation in the era of IoT and industry 5.0: Absolute innovation management (AIM) framework", *Information*, Vol. 11, No. 2, pp. 124.
- [19] Kaplan, A.M. and Haenlein, M. (2006), "Toward a parsimonious definition of traditional and electronic mass customization", *Journal of product innovation management*, Vol. 23, No. 2, pp. 168-182.
- [20] Pine, B.J., Peppers, D. and Rogers, M. (2009), *Do you want to keep your customers forever?*, Harvard Business Press.
- [21] Frederico, G.F. (2021), "From supply chain 4.0 to supply chain 5.0: Findings from a systematic literature review and research directions", *Logistics*, Vol. 5, No. 3, pp. 49.
- [22] Aichner, T. and Coletti, P. (2013), "Customers' online shopping preferences in mass customization", *Journal of Direct, Data and Digital Marketing Practice*, Vol. 15, No. 1, pp. 20-35.
- [23] Randall, T., Terwiesch, C. and Ulrich, K.T. (2005), "Principles for user design of customized products", *California Management Review*, Vol. 47, No. 4, pp. 68-85.
- [24] Trentin, A., Perin, E. and Forza, C. (2013), "Sales configurator capabilities to avoid the product variety paradox: Construct development and validation", *Computers in Industry*, Vol. 64, No. 4, pp. 436-447.
- [25] Trentin, A., Perin, E. and Forza, C. (2014), "Increasing the consumer-perceived benefits of a mass-customization experience through sales-configurator capabilities", *Computers in Industry*, Vol. 65, No. 4, pp. 693-705.
- [26] Tiihonen, J. and Felfernig, A. (2010), "Towards recommending configurable offerings", *International Journal of Mass Customisation*, Vol. 3, No. 4, pp. 389-406.
- [27] Falkner, A., Felfernig, A. and Haag, A. (2011), "Recommendation technologies for configurable products", *Ai Magazine*, Vol. 32, No. 3, pp. 99-108.
- [28] Merle, A., Chandon, J.L., Roux, E. and Alizon, F. (2010), "Perceived value of the mass-customized product and mass customization experience for individual consumers", *Production and Operations Management*, Vol. 19, No. 5, pp. 503-514.
- [29] Turner, F., Merle, A. and Gotteland, D. (2020), "Enhancing consumer value of the co-design experience in mass customization", *Journal of Business Research*, Vol. 117, No. pp. 473-483.
- [30] Sandrin, E., Trentin, A., Grosso, C. and Forza, C. (2017), "Enhancing the consumer-perceived benefits of a mass-customized product through its online sales configurator: An empirical examination", *Industrial Management & Data Systems*, Vol. 117, No. 6, pp. 1295-1315.
- [31] Trentin, A., Aichner, T., Sandrin, E. and Forza, C. (2020), "Competing through manufacturing: countering a product's liability of foreignness through mass customization", *International Journal of Operations & Production Management*, Vol. No. pp.
- [32] Zeng, S.X.; Liu, H.C.; Tam, C.M.; Shao, Y.K. (2008), "Cluster analysis for studying industrial sustainability: An empirical study in Shanghai." *J. Clean. Prod.*, Vo.16, No 10, 1090–1097.

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