

Managing Open Twin Transition in SMEs: A Case Study in the Fashion Industry

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Abstract: According to the French Agency for Ecological Transition, ADEME, the textile sector is projected to contribute to 26% of global greenhouse gas emissions by 2050, highlighting the significance of sustainable fashion. The current market, influenced by increasingly conscientious consumers seeking transparency regarding product origins and production conditions, alongside stricter regulations, compels fashion companies to diminish their environmental footprint by embracing progressively sustainable and eco-friendly practices. With the ability to purchase garments online from anywhere in the world, the necessity of providing clear and accurate information to customers and the supply chain about product features through a document in a smart format has become essential. Consequently, digitization has become imperative in the fashion industry, with the digital passport serving as a pivotal milestone in advancing towards an eco-friendly and more digitalized sector. However, small, and medium-sized enterprises (SMEs) face an uncertain landscape where standards and technologies may not always be mature or readily accessible. Furthermore, limited internal expertise and scarce financial resources often pose challenges in independently developing new technological solutions. One proposed solution is to adopt open innovation approaches. This qualitative research study employs a single case study approach, presenting insights from a small enterprise in the fashion industry specializing in label printing. Utilizing primary data sources such as multiple interviews with managers and secondary sources like detailed briefings of company meetings with technological partners and machinery suppliers, the study aims to shed light on the initial phase of an open innovation approach by SMEs amidst the challenges of twin transition. It highlights that the shift from internal RD& to open innovation is not a direct one, but an iterative one. Scholars will gain a deeper understanding of open innovation mechanisms within SMEs, while practitioners will gain insights into building innovation networks to navigate twin transition challenges.

Keywords: SMEs, Twin transition, Open Innovation, Case study

1. Introduction

In an era of globalized online shopping, the transparency and traceability of garments have become increasingly vital. The introduction of the "*digital passport*" for garments marks a revolutionary step in the fashion industry's journey toward sustainability and digitization. This digital document, accessible through QR codes, NFC, or blockchain technology, encapsulates the entire lifecycle of a garment—from the sourcing of raw materials to its final disposal. It provides comprehensive details such as the origins, manufacturing processes, environmental impacts, and recyclability of the product (*Forbes* – 01-16-24). The digital passport is not just an informational tool; it is a strategic response to the urgent need for an eco-friendly transformation within the fashion industry. Initiated by visionary leaders like Federico Marchetti and supported by an innovative collaboration under the Fashion Task Force, this initiative leverages technology to enhance consumer engagement and foster responsible production practices. By equipping consumers with detailed knowledge about their clothing's environmental and social footprint, the digital passport empowers them to make informed purchasing decisions (*Il Sole 24 Ore*).

When a company, particularly a small-to-medium enterprise (SME), faces a situation of uncertainty, it may begin to collaborate with customers and suppliers (Nieto and Santamaria, 2010). Choosing an open innovation approach represents both an opportunity for SMEs to keep pace with the challenges posed by the market (Van de Vrande, 2009), but also a criticality due to their limited formalization and smaller networks (Spithoven, Vanhaverbeke, and Roijakkers, 2012).

This paper, starting from the challenges posed by the twin transition and the opportunities offered by open innovation, aims to understand through which mechanisms small-to-medium enterprises transition from a closed to an open innovation approach. This is a phenomenon still scarcely explored in the literature, which merits the attention of both scholars and practitioners. To do this, a case study related to the fashion industry is presented, where the anticipated introduction of a digital passport for clothing presents many uncertainties for smaller firms. The paper provides a) a brief literature review on open innovation in SMEs b) a detailed

presentation of the methodology used c) the presentation of findings and their theoretical discussion. The paper concludes by providing directions for future research lines.

2. Literature Review

2.1 Open Innovation: SMEs vs Large Enterprise

In the realm of open innovation (OI), the comparative strengths and weaknesses of small and medium-sized enterprises (SMEs) versus large firms are nuanced and complex. Large firms enjoy resource advantages, and SMEs leverage behavioral strengths such as entrepreneurship and flexibility, which foster quicker decision-making and innovativeness (Narula, 2004). SMEs also adeptly align employee incentives with innovative efforts, enhancing their responsiveness to market opportunities (Holmstrom, 1989; Zenger, 1994). However, SMEs face significant challenges, primarily in accessing critical resources and capabilities for innovation (Hewitt-Dundas, 2006). Large firms, with their scale and scope advantages, are better positioned for innovations that demand specialized teams or sophisticated equipment, allowing them to amortize the fixed costs of innovation across higher sales volumes (Cohen and Klepper, 1996). In contrast, SMEs often struggle with technological resource acquisition, recruitment of skilled staff, and continuous employee training (Bougrain and Haudeville, 2002). The implementation of OI strategies also varies with the size of the enterprise. Large firms typically focus on R&D collaborations during the technology exploration phase, whereas SMEs emphasize the commercialization phase (Lee, 2010; Narula, 2002). SMEs can benefit from limited internal resources by engaging in vertical collaborations with suppliers and clients to innovate effectively (Nieto and Santamaria, 2010). As SMEs mature, they often adopt more formal structures to manage their innovation processes, gradually mirroring the structured and professionalized innovation approaches of larger firms (Vareska van de Vrande et al., 2009). Nevertheless, SMEs inherently face greater risks in engaging with OI due to their limited formalization and smaller networks (Spithoven, Vanhaverbeke, and Roijakkers, 2012). Larger firms generally make more extensive use of OI practices to introduce new products or services, benefiting from cost and time efficiencies sourced from external knowledge (Chesbrough, 2006). Conversely, SMEs are adept at responding to market needs through organizational flexibility and less bureaucracy, though they are constrained by resource limitations (Cassiman and Veugelers, 2006). Interestingly, while SMEs may introduce fewer new products or services compared to large firms, their reliance on OI results in a significant portion of their turnover being derived from such innovations, effectively equalizing the impact of OI practices on both SMEs and large firms (Spithoven, Vanhaverbeke, and Roijakkers, 2012). This indicates that while large companies have superior absorptive capacity, the tangible impacts of OI practices on market introduction and turnover generation from innovations are comparable across firm size (ibidem)

2.2 Open Innovation in SMEs

Van de Vrande (2009) highlights that SMEs adopt OI to keep up with market developments, swiftly develop products, incorporate new technologies, and enhance their innovation processes and brand reputation. Additionally, Venturini and Verbano (2012) emphasize that SMEs seek external partners to compensate for internal skill shortages, integrate diverse competencies, stimulate creativity, and share risks and costs associated with new technological developments. However, the implementation of OI is not without challenges. Igartua, Garrigós, and Hervás-Oliver (2010) discuss barriers such as limited time and financial resources, and managerial issues. Muzzi and Albertini (2015), among others, point out that the limited size of SMEs often results in challenges like constrained cognitive capacities and lack of experience in collaboration, which are barriers to effective OI. Ahn (2017) and others further categorize these obstacles according to the types of OI—whether it involves acquiring knowledge (inbound OI), co-creation (coupled OI), or transferring knowledge (outbound OI). SMEs face both internal and external barriers in adopting OI. Internally, common challenges include a lack of time, financial resources, expertise, and a culture resistant to openness (Grimaldi, Greco, and Cricelli, 2021; Lam, 2013). These internal barriers are also reflected in attitudes like the ‘not invented here’ or ‘not sold here’ syndromes, which can stifle innovation efforts (Chesbrough and Crowther, 2006).

Externally, SMEs struggle with finding appropriate partners, dealing with demand uncertainty, navigating legal ambiguities around intellectual property, and overcoming administrative burdens (Dziurski and Sopińska, 2020). The challenge of finding partners is compounded by issues like lack of social and cognitive proximity, which can hinder effective communication and collaboration (Albats, 2020). Granstrand (1997) noted the growing need for firms to possess multiple technological competencies due to the increased knowledge content in products and cross-fertilization of technology areas. Rajneesh Narula (2002) observed that firms are increasingly adopting non-internal technology development strategies such as strategic alliances and outsourcing, benefiting firms of all sizes. According to Cassiman (1999), Hagedoorn (2000), Bayona (2001), and Caloghirou (2003), technological

collaboration serves as a strategic mechanism to enhance technological capabilities, access new markets, secure public funding, and complete the innovation process. María Jesús Nieto and Lluís Santamaria (2006) stated, “Technological collaboration may be a good way to improve innovativeness of SMEs strengthening and complementing their lack of resources and capabilities.” Narula (2002) highlighted that both large and small firms engage in R&D collaboration to shorten innovation time and access complementary technologies, but large firms are better positioned to form partnerships. Narula (2001) differentiated firms’ decisions on internal versus external R&D based on the centrality of technological competence to their activities, with strategic competencies likely developed in-house and less critical ones through partnerships or outsourcing. SMEs weigh the use of non-internal means more cautiously due to their vulnerability and concerns over losing technological assets Narula (2001). Innovation partnerships stimulate SMEs’ innovation capabilities, helping them overcome growth barriers due to limited resources and boosting their competitiveness (van Dijk, 1997). Nieto and Santamaria (2006) also suggested that technological collaboration can significantly enhance SMEs’ innovation capacities, allowing them to bridge the gap with larger firms. Jill L. Sawers, Marthinus W. Pretorius, and Leon A.G. Oerlemans (2008) highlighted the potential hazards of collaboration for small firms, particularly the asymmetric nature of partnerships which often benefits larger firms more. They noted the importance of safeguarding strategic capabilities through formal and informal mechanisms to prevent unintentional knowledge flows to larger partners. They identified three main safeguarding mechanisms: market, bureaucratic, and informal social mechanisms, with trust playing a critical role in the success of partnerships.

As emerged from the literature review, scholars have long studied open innovation. The literature, however, appears to be still fragmented. Many studies focus on the antecedents and the outcome of OI in SMEs, however, the mechanisms that govern the change toward an open innovation approach are still quite unexplored in SMEs. This topic is becoming more relevant since European SMEs, particularly those working in the fashion industry, will be facing a huge challenge in adapting to the twin transition.

3. Methodology

The present study has been conceived as a descriptive single case study Yin (2014). The case study methodology is particularly fitting when research inquiries are open-ended and aim to dissect intricate phenomena (Yin, 2014), such SMEs shift towards open innovation. This research project has the main objective of understanding the complex dynamics that govern the change from a closed approach to innovation to an open approach to innovation. The unit of analysis is the single SME, taken as an object of analysis in the month through which open innovation has been pursued. The fashion industry has been set as the setting of the case for the challenges offered by the introduction of the “digital passport”. Data has been collected from 8 interviews with managers of the firm (see Table 1); only decision-makers have been involved in the interviews. All the interviewees were interviewed in multiple rounds and semi-structured interviews were used. The first interview was used to understand the situation ex-ante, while a further round was used to deep dive into the relationships with the different external partners and the action that the company undertook to tackle the twin transition (i.e. digital passport). Interviews have been complemented with the verbatim transcript of 7 meetings with external partners and summary reports of other informal meetings. Data collected refers to a period of 12 months. Other materials have been collected to triangulate data (such as documents for a public call). The names of the companies involved in the meeting have been anonymized. This study will present an explorative analysis.

Table 1: List of meetings recorded and transcribed verbatim

REPORT MEETING		
DATE	COMPANY	ATTENDEES FROM ITALIAN LABEL FACTORY
24/07/2023	Blue	Sales manager and tech leader
24/07/2023	Black	Sales manager
13/10/2023	Red	Sales manager and tech leader
28/11/2023	Green	CEO
07/11/2023	Yellow	CEO
16/11/2023	Purple	CEO, sales manager, tech leader
21/11/2023	White	Sales manager

Table 2: Company description

COMPANY	DESCRIPTION
Blue	involved in making machinery for effective label weaving
Black	is part of the Arancione Group and is involved in the development of RFID technology implemented in the world of weaving and woven labels
Red	makes machinery for the packaging stage of woven labels (cutting, folding, and bagging)
Green	assembles weaving machinery by buying the various components (loom body, pavilion, etc...) from different suppliers which he then operates through the implementation of his own software
Yellow	offers a consultancy service in which its technical knowledge and contacts are made available to create a kind of partnership during which the client is assisted and supported in the process of conceiving, developing, and introducing an invention that is then filed with a joint patent
Purple	produces machinery for automatic labelling of different types of products, offering its expertise in electronics, logic, and software within a partnership with another company that instead supplies the mechanical and component parts
White	deals only with the trade and distribution of RFID microchips (even in small quantities)
Arancione	is a group within which several companies, operating in the textile supply chain, are included to offer all the products needed by garment makers and brands to carry out the final stage of garment making and customization
Azzurro	is engaged in microchip manufacturing by investing in research and development in the field of RFID technology
Rosa	oversees packaging and trading the finished garments that will then be sold directly to the end consumer

4. Case description

“Italian Label Factory” (anonymized name) is an Italian SME active in the textile sector of fashion and apparel, established in 1961, which has contributed to the disastrous environmental impact. Its core business is the production of woven ribbons and labels for garment packaging and customization.

On the customer side, *Italian Label Factory* is very active and involved in terms of innovation and collaboration, having a kind of internal R&D department made up directly of its own sales team. This team offers insights based on past work and leverages its skills and knowledge, working closely with customers to support them in the development of new products that better meet their needs (and potentially those of others as well). By combining multiple roles simultaneously (R&D and sales), the company avoids having a dedicated internal R&D department, saving resources, and increasing flexibility. On the supplier side, *Italian Label Factory* is less involved in terms of R&D, lacking the necessary skills to have a specific internal department but relying on its trusted and longstanding suppliers who propose new technologies and/or improvements that enhance the performance of existing machinery using feedback received from various customers. Although resources are saved by not allocating them to an R&D department, lacking any internal innovative competence poses the risk of becoming dependent on suppliers who can decide whom to provide their technologies/innovations to (including competitors).

The green transition to reduce the environmental impact caused by the textile sector is no longer postponable, and *Italian Label Factory* has always been very sensitive to these issues. Already in 2019, it implemented the use of recycled yarn proposed by the most avant-garde suppliers, but today, to be sustainable, it is necessary to have visibility and control over one's own production chain by tracking one's garments even after the sale, optimizing their disposal and recycling process. The digital passport encapsulates a multitude of opportunities by optimizing logistic processes and reducing the environmental impact of each garment. Being in 2024, the only risk is that of mistiming by moving too early in offering customers a more expensive product whose benefits they do not fully understand yet. Moving too late, they would lose the advantages linked to being the first to find a solution, risking having to comply with already registered patents.

5. Findings

To better understand the mechanism that led Italian Label Factory to open innovation, we read the data collected using a micro perspective and segmenting the transition from internal *R&D only* to open innovation in several phases:

Phase 0 – Uncertainty and open-innovation dilemma. Italian Label Factory finds itself in a context of high uncertainty where there are still no precise laws regarding the restrictions that will come into force from 2030 and the parameters to comply with them. To improve the global sustainability of the textile sector, it was thought to develop a solution that could reconcile RFID technology with classic woven labels into a single product and, through the traceability of garments, optimize the management of logistics and their disposal/recycling. From the beginning, it was necessary to determine whether it was better to develop a solution internally using one's own skills and contacts to fully enjoy the potential advantages or whether to collaborate through partnerships with suppliers and customers, with whom the potential advantages of developing a winning solution would also have to be shared.

Phase 1. The first approach to open innovation. Through discussions with Italian Label Factory's current machinery suppliers (Blue), it was investigated how they could support their project and how they were addressing the introduction of the digital garment passport.

"From the very first phone contacts with Blu, it was clear that it was not going to be as easy as we initially imagined" (Owner of Italian Label Factory).

Having sensed the opportunity from the beginning, Italian Label Factory thought it could not develop a winning solution on its own: it contacted the main and historical supplier of weaving machinery, Blue, to commission a loom capable of weaving the label and simultaneously inserting RFID technology. Blue had abandoned the research and development of RFID technology implemented in classic weaving, ceding the dedicated division (Black) to the Orange group. Speaking with Black, they had patented with Orange a particular self-adhesive RFID to be applied to the back of the woven label as an interim solution.

Phase 2 – Back to a closed innovation approach. Managers from Italian Label Factory perceived feeling was that somehow, they wanted to disincentivize Italian Label Factory from working with them and adopt this kind of solution. The perceived hostility, however, convinced the company that they were moving in the right direction and that the self-adhesive solution is indeed currently feasible to meet the need for traceability of garments.

"We come back disappointed but at the same time we interpreted this hostility in wanting to share this new technology as a kind of increased awareness in the fact that we are moving in the right direction"(Sales manager of Italian Label Factory).

Therefore, Italian Label Factory tries to invest internally with a closed innovation to develop a similar solution to offer to its customers.

Phase 3 – Towards an open innovation approach. The absence of an internal R&D department (supplier side) and any competence to develop a loom capable of reconciling the weaving of labels with RFID technology and knowledge in the field of RFID to develop an interim solution like the self-adhesive one, however, pushed Italian Label Factory to rely on Yellow, a consulting firm for innovations in traceability and logistics, which offers its technical knowledge and contacts to find the best manufacturers in the world to supply, accompanying and supporting the process of conceiving, developing, and introducing a new innovation to then file a joint patent.

Phase 4 – Building an innovation network. The contacts suggested by Yellow were abandoned and it was decided to share the project with more actors where each provides their skills, knowledge, technologies, and machinery to develop and offer this product to the final customer. The company understood that such a challenge should be addressed in a multi-partner open innovation network.

Phase 5 – Open-innovation: co-development of a solution. In the following months of meetings and ecological transition, Italian Label Factory has collaborated more by broadening its base of suppliers by turning for the first time to the direct competitors of Blue.

"I recalled that when I met with Green this summer during ITMA 2023, they mentioned something about the digital passport and the opportunity it represented for all players in the textile supply chain. Considering recent developments, I felt it was my duty to contact them and arrange a meeting as soon as possible" (Owner of Italian Label Factory).

Green is a very innovative reality sensitive to the theme of the introduction of the digital passport having understood the potential, the limits of the self-adhesive solution, and the inability to develop a loom capable of weaving the yarn with the aluminum fiber antenna simultaneously. The collaboration was successful. The solution devised in collaboration with Green consists of weaving a tubular label with a small cut on the back that creates a sort of pocket inside which the RFID chip will then be mechanically inserted. This slit is then closed by sewing the label on the garment so that the chip does not come out separating from the garment during its useful life.

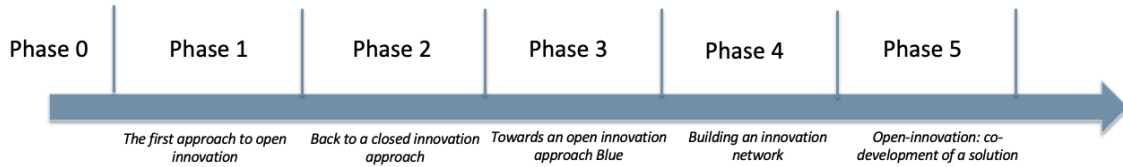


Figure 1: Project timeline

6. Discussions

This work, although exploratory in nature, sheds light on the mechanisms that lead an SME to adopt an open approach.

Nowadays textile companies are working in the same context that is described in the literature by Milliken (1987) when it comes to the concept of environmental uncertainty. These SMEs are experiencing a high level of environmental uncertainty due to the lack of critical information regarding the content of the regulations that will govern the use and introduction of the digital garment passport in 2030. Consequently, it's not possible to predict future events by regulatory forces (*"state uncertainty"*), and we are not able to understand what impact this innovation will have on companies (*"effect uncertainty"*), and which solution will be the most appropriate to adopt (*"response uncertainty"*) between that of self-adhesive RFID and that with the tubular tag containing RFID (or another one not yet thought of). Therefore, companies in the textile supply chain remain in a stalemate where they are unable to make decisions since they do not yet know the standards to which they will have to adhere.

To reduce this uncertainty, as also explained by Schoemaker and Day (2009), Italian Label Factory keeps in constant contact with the actors in its supply chain leveraging extended networks to gather more information and scan weak signals about potential opportunities coming from the market and decides to change its approach by *"adopting multiple perspectives to get a better peripheral view"*.

Italian Label Factory has changed its approach and, as explained earlier by Chesbrough (2003), has shifted from seeking a solution through close innovation in which it relied solely on its own internal R&D and its own strengths and resources, to an open innovation approach by relying on external information and resources by opening up to collaborations with other players in the supply chain with whom knowledge, ideas and technologies are shared so as to make up for the scarce resources in the innovation phase that distinguish SMEs from large companies.

Through this type of approach, as explained by Dahl and Moreau (2002), SMEs can compete in the market by finding better solutions than those sought by large companies through their R&D departments since they are the result of the vision and mix of skills and knowledge of several actors at once. This is the case of Italian Label Factory and the actors who participated in the partnership, who were able to develop a solution (tubular label with RFID inside the pocket) that was far better than that of the big industry giants (self-adhesive application of RFID on the back of the woven label) and able to meet the requirements of the introduction of the digital garment passport.

One of the most important contributions of this work in the academic literature is the explanation of open innovation in SMEs as a trial-and-error approach between closed and open innovation approaches. Moreover, it shows that this process is first guided by a more passive approach (*exploitation of the known partner*) and then by a more active approach (*scouting of a new partner*). We show that the transition from internal R&D to open innovation is not a linear process, but an iterative process that makes the company shift multiple times from closeness to openness and vice versa. Leveraging pre-existing knowledge ties and tackling hostility and

discouragement, searching for a partner appear to be the antecedents that led an SME to shift several times from internal R&D to open innovation.

From a practitioner's point of view, this paper offers interesting insight that managers could follow. It shows how building on existing ties could lead to hostility or discouragement in pursuing an open innovation approach and trying to stick to internal R&D. If the company locks in with this approach it will be not able to tackle new challenges. Moreover, it highlights how open innovation between companies that face similar challenges can lead to the development of new products, more effective than the ones offered by the market.

7. Conclusion, Limitations, and Further Research Avenues

This research paper achieves a dual objective. On one hand, by situating itself within the literature on open innovation, it confirms some of the evidence from both qualitative and quantitative studies concerning open innovation in small and medium enterprises (SMEs). On the other hand, it enriches the literature by exploring the mechanisms that enable a small firm to transition from a closed to an open innovation approach. Moreover, it utilizes the perspective of open innovation to understand how SMEs handle the twin transition, an emerging trend of great significance for both practitioners and scholars.

However, this study is not without limitations. Although the use of a single-case study is beneficial for understanding new phenomena, such as the twin transition in SMEs, future research could aim to broaden the sample of cases by a) extending the analysis to the fashion industry, considering other types of productive activities that will be impacted by the introduction of the “digital passport,” and b) expanding the analysis with a cross-industry perspective. It should be noted, however, that this case clearly represents the complexities and the climate of uncertainty that many small enterprises are currently facing. The data was collected over a 12-month period of the project conducted by Italian Label Factory. Although this time frame is sufficient to study the phenomenon in question—specifically the transition from a closed to an open approach—it would be interesting to conduct a longitudinal analysis that follows the company up to 2030 and the official introduction of the digital passport.

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