Developing a new frame for categorising use cases of RFID in the fashion and apparel sector

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Abstract: This paper proposes a new frame of reference for classifying the deployments of Radio Frequency IDENTification (RFID) technique in the field of fashion and apparel retailing. This frame comprehends all different use cases that can be found in the apparel retail sector, and it updates and expands what has already been done in scientific literature in this field. After a comprehensive analysis of the scientific literature, business journals, web portals, websites and blogs, the mentioned frame was built and it counts two levels. At a first level, 6 different categories of use cases were defined and described. At a greater detail, i.e. at level 2, each one of these categories was broken into 1 to 4 specific use cases, and these level 2 use cases describe very precise objectives pursued by an RFID implementation in the given business sector. Eventually, the proposed frame was validated by a panel of industry partners.

The authors believe that the frame of reference proposed could be extremely useful for researchers and practitioners, because it presents a comprehensive, complete and up-to-date framework for categorizing deployments of RFID in the apparel and fashion retail, outlining opportunities and new research spaces about RFID deployments in the industry.

Keywords: fashion and apparel retailing; RFID deployment; use cases; RFID technology.

1. Introduction

As several authors agree (see for example (Azevedo & Carvalho, 2012), the fashion and apparel industry is a dynamic scenario, characterized by unpredictable demand, high variety and short life cycles of products. In a certain way, in fact, garments can be considered “perishable” goods, which means that changing trends can make older products out-of-date and significantly decrease their selling prices.

In this context, it is very important to strike a profitable balance between ordering too much product in advance, and therefore risking products obsolescence and decreasing revenues, and ordering too less, that can result in lost sales. Practically, it is the effective management of the supply chain itself that makes it possible to put the right item (i.e. right model, right colour and right size) in the retail store at the right time, as indicated by (Fisher, 1997).

Although the first projects of RFID in the fashion and apparel retail mostly consisted of deployments in distribution centres and logistics processes, the trend of the last decade has seen the RFID tagging at item level to emerge as an excellent tool to achieve effective supply chain management (Bottani, Ferretti, Montanari, & Rizzi, 2009).

Amongst the first deployments of RFID at item level within the fashion and apparel sector we can surely cite the following contributions. In 2006, the Federation for the German Retail Trade suggested (Lippok, 2006) that RFID was almost ready to make a real breakthrough in the fashion retailing; the members of the federation, however, did not agree on when this breakthrough was going to happen. In the same year, (Koh, Kim, & Kim, 2006) suggested an important relationship between benefits of RFID and the strategic impact on business performance by identifying four main categories of benefits and three major risk factors of RFID in fashion retailing.

A couple of years later, (Loebbecke, Huyskens, & Gogan, 2008) reported an original endeavour to perform an end-to-end item-level tracking of items through the point-of-sale of a German retailer. In 2009, a few studies dealt with the economic feasibility of RFID in fashion retailing. For example, (Bottani et al., 2009) examined different configurations of the supply chain and assessed the impact of RFID on the fashion industry supply chain; (Mogre, Perego, & Tumino, 2009) specifically designed a cost-benefit calculator for the implementations of RFID within the same industry sector.

One of the most active and productive research groups in this research space is the University of Arkansas RFID research centre. This centre pioneered item level tagging research since the second half of ’90. Although many papers have not been published in scientific outlets, they
are available on the lab web site and represent a milestone in this space. In 2010, an interesting paper by Fernie et al. (Fernie, Sparks, & McKinnon, 2010) reviewed the British retailing sector over the previous three decades, reporting its transformations and sketching possible future challenges to be met. (Wong, Leung, Guo, Zeng, & Mok, 2012) greatly improved sales performances of a fashion retailer through a RFID-enabled cross-selling technique. In the same year, (Bertolini, Bottani, Ferretti, Rizzi, & Volpi, 2012) quantified the benefits achievable through RFID deployment in the apparel and fashion SC (e.g. increased visibility of products flows, increased accuracy, reduced labour costs and increased sales). Also in 2012, Bottani et al. (Bottani, Ferretti, Montanari, Rizzi, & Volpi, 2012) explored the potential and provided an economic justification for deploying RFID for anti-theft purposes.

In the last two years, another study proposed a threshold-based classification with a pre-set level of accuracy that can deliver a given trade-off between efficiency and accuracy of an RFID implementation (Luo, Qiao, & Chen, 2013). Also, (Buse casekkel & Thiesse, 2014) developed different decision aids and provided a methodological approach to supports practitioners in the optimization of RFID installations in the fashion retail: the outcomes of this study provide more reliable data and enable the generation of brand new performance indicators and short reports for management.

It is worth noting that the fashion and apparel retailing is the only industry that can count so many different use cases of RFID, stretching from customer relationship to shop floor management, from inventory management to brand protection, and from marketing and promotion management to logistics.

However, although the large number and high variety of different use cases of the sector, only one study is available in the literature with an attempt to categorize the previously mentioned use cases (Moon & Ngai, 2008). The authors of this paper analysed the points of view of some fashion retailers on RFID implementations, and built up a business value added framework that comprehends different “fashion retailing activities”, i.e. (i) shop floor management, (ii) customer relationship management, (iii) marketing and promotion management and (iv) logistics and inventory management.

Although this paper sets the ground for our study, we believe that a significant value could be added by expanding its data base with new relevant use cases that emerged in the industry and updating it after 7 years of continuing RFID improvement and innovation. Moreover, it may be worth expanding these four branches of activities in multiple subcategories, so as to achieve a more detailed frame of reference that could accommodate different scopes of technology deployments.

Based on these premises, the goal of our study is to build up an up-to-date, complete and well-detailed taxonomy for use cases of RFID in the fashion and apparel retail sector, based on an extensive literature review. This frame of reference will be reported in the following Section, and Section 3 will draw conclusions and sketch possible future directions for research.

2. The proposed framework for RFID deployment in fashion and apparel retail

As already mentioned before, we adapted our framework from the business value added framework of (Moon & Ngai 2008). This taxonomy is reported in Figure 1. We propose an extension of this framework to build up an up to date, complete and well-detailed frame of reference for USE CASEs of RFID in the fashion and apparel retailing as reported in Figure 2.

Within our proposal, the industry sector, i.e. fashion retailing, is reported at level 0, while level 1 indicates the scopes of RFID, and level 2 identifies and defines specific use cases.

The use cases at level 1 can be seen as categories that group level 2 use cases according to some common feature, such as the general objective of RFID deployment, its physical place, or the kind of business processes managed through RFID technology. Also, it is important to note that, both at level 1 and level 2, use cases are not mutually exclusives, i.e. any RFID project can be classified in more than just one use case, and they may, somehow, overlap each other, according to different points of view and perspectives. Sometimes, in fact, the same RFID deployment could fall under two or more different use cases.

The use cases at level one can be described as follows:

i. **Shop Floor Management** comprehends all activities meant to properly manage shop floor processes. Its main aim is to assist salespersons and managers to better carry out the appointed tasks;

ii. **Customer Relationship Management** brings together all use cases aimed at improving and enhancing shopping experience;

iii. **Marketing and Promotion Management** comprehends all RFID-enabled use cases whose main aim is to increase the company turnover;

iv. **Logistics** categorizes all use cases whose main goal is to reduce labour and/or increase process accuracy. This is particularly the case for inbound/outbound processes and inventory counts;

v. **Inventory and Supply Chain Management** aims to increase inventory accuracy and visibility throughout the supply chain.

vi. **Brand Protection** embraces all RFID projects and deployments aimed at fighting illegal markets and/or counterfeiting, as well as at strengthening brand protection.

As it was already mentioned above, level 1 use cases can be seen as general umbrellas for one or more level 2 use cases, as they will be described below.
1.1 Locating items

The first use case deals with locating specific items in real time within a store (either on the shop floor or in the backroom). RFID technology, in fact, can read tags in real time through fixed infrastructures, and confirm to store associates where to find a specific garment.

1.2 Loss prevention

Thefts are a critical issue in retailing. Recent studies, however, demonstrate that RFID can outpace performances of traditional EAS technologies under some circumstances (Bottani et al., 2012; Hardgrave, 2009). Whenever a deployment of RFID aims at reducing losses or identifying stolen items we will categorize it as “loss prevention”.

1.3 POS transaction / Faster checkout

The time required for a Point Of Sale (POS) transaction is a critical issue in fashion and apparel retailing: the shorter the checkout queue, the better the service provided to customer. Because of this issue, more and more companies are working to automate this time-consuming task, and RFID technology is often exploited to this extent.

1.4 Stock visibility / Replenishment from the backroom

RFID makes it possible to automatically track items when they are moved from the backroom to the shop floor and vice versa. This feature is extremely relevant when the store area is limited, and only a small portion of models/colours/sizes can be concurrently displayed on the sales floor. RFID provides store associates with separate inventory levels, and therefore it enables replenishments policies based on real inventory levels, reducing out of stock.

2.1 Social shopping

Social network websites are one of the most important changes of the last 10 years, a period in which they have constantly increased in number and users (Boyd & Ellison, 2007): therefore, under this use case, we grouped RFID projects aimed at identifying both the garments and the customer through RFID tags so as to enable the social shopping experience, i.e. the possibility to automatically
post in customer’s Facebook wall the information about the garments he/she is interested in.

2.2 Store associate availability / Customer knowledge

Another important use case of RFID relates to customer knowledge. With this term we mean the possibility to real time identify through an RFID enabled fidelity card customers as they enter the store and categorise them depending on their sales records. Therefore, when customers enter the store, the card is read through RFID gates at the store entrance, and the information is instantly made available to store associates, who will provide the customer with a customized service.

3.1 Customer experience

Under this umbrella we defined RFID applications aimed at increasing the customer shopping experience through tools such as magic mirrors, smart fitting rooms, kiosks or shelves and the like.

A “magic mirror” is an augmented reality device that allows customers to “virtually” trying on garments. Other similar means to raise customer experience through RFID are smart shelves and kiosks, that provide the customers with all the information related to a particular garment.

3.2 Cross-selling / Cross-promotions

Cross-selling defines the practice of selling or suggesting related or complimentary products to a prospect or customer. Cross-promotion, on the other hand, defines a retail selling technique in which purchase of one item allows an automatic discount on a different but related product. Thanks to RFID, bricks & mortar retailers can leverage cross marketing and cross promotion strategies to increase sales, just like online retailers do on their websites.

3.3 Store associate empowerment

By means of an RFID reader, every garment can be exactly identified and the legacy system can display information about best matching products (accessories, garments or footwear) to any store associate on a desktop or mobile device, by telephone or in a bricks and mortar store. Several studies in the literature affirm that omnichannel will shape both the future of brick-and-mortar stores as well as e-commerce stores (see for example Anders, 2014). RFID is a vital vehicle to enable omnichanneling, because of the high inventory accuracy levels this technology can lead to. Therefore, we considered under the umbrella of use case 5.2 every RFID deployment aimed at implementing omnichannel strategy.

4.1 Process automation

This use case encompasses all the implementations of RFID whose main aim is to automate already existing processes, that is to say processes that were already carried out before the RFID implementation (e.g. receiving processes, inventory cycle counts, shipping processes etcetera). It must be clear that, whenever RFID enables new processes, they will not be considered as “process automation”.

4.2 Process accuracy

Similarly to the previous one, this use case deals with the increase in process accuracy due to RFID. Most of the remarks made for the previous use case, in fact, are also valid for process accuracy: the main difference between these two use cases is that, in the first one (4.1), the use of RFID aims at increasing productivity, while in the second one (4.2), the goal is to reduce errors and therefore increase accuracy.

4.3 After sales / Returns

This RFID use case aims at streamlining the flow of (i) products returned from the customer to the store, i.e. after sales, and (ii) unsold products that, at the end of a season, are returned from the store to the DC.

Although these two issues are quite different, they are considered under the same umbrella because they both deal with the use of RFID to manage the backward flow of goods.

5.1 Out of stock / Inventory accuracy

This use case refers to one of the most frequent use of RFID in real world deployments, i.e. to reduce out of stock through higher inventory accuracy. This is particularly the case for “replenishable” products, which are products that may be replenished during the season.

The aim of this use case is to leverage RFID to avoid the situations where a garment is out of stock in the store level (i.e. both in the sales floor and in the backroom) but it is not seen as out of stock by the ERP system and therefore not replenished from the DC. RFID technology, in fact, “is the only efficient way to achieve in-store inventory accuracy” (Hardgrave, 2012).

5.2 Omnichanneling

Omnichannel is a multichannel approach to sales that seeks to provide the customer with a seamless shopping experience whether the customer is shopping online from a desktop or mobile device, by telephone or in a bricks and mortar store. Several studies in the literature affirm that omnichannel will shape both the future of brick-and-mortar stores as well as e-commerce stores (see for example Anders, 2014). RFID is a vital vehicle to enable omnichanneling, because of the high inventory accuracy levels this technology can lead to. Therefore, we considered under the umbrella of use case 5.2 every RFID deployment aimed at implementing omnichannel strategy.

5.3 Supply chain visibility

Another important level 2 use case is supply chain visibility (5.3). RFID holds the potentials for making the information visible to all participants throughout the value chain, because it enables to distribute in real time, without information delays, the information of different levels and types. Therefore we consider under this use case every RFID implementation that allows either the customers or in general every supply chain stakeholder to have visibility of (i) the flow of goods and (ii) the availability of specific products through the entire supply chain.
6.1 Grey market

“Grey market”, also known as “parallel market”, can be defined as the unfair trade and sale of goods by dealers. Grey products are not counterfeited goods, but genuine ones sold by unauthorised parties. Dealers may purchase genuine products in greater volumes and low prices, and redirected part of them to more profitable markets for unfair gains, without going through the official distributors. RFID can be a very effective tool to fight grey market, because tag serials can be linked to first tier customers, and this allows to determine whether a product is or is not where it was meant to be.

6.2 Counterfeiting

This use case is closely related to the previous one, although technically different, and it encompasses RFID deployments where the main aim is to detect counterfeited products. RFID, in fact, makes it extremely expensive, and not economically feasible, to counterfeit a tag, as long as a simple supervisor may just walk into any retail store and detect fake products from genuine ones by means of a handheld reader.

6.3 Traceability

The last level 2 use case comprehends the deployments of RFID towards a particular and indirect way to assess if a fashion product is genuine and to ensure its quality: that is to punctually trace all the SC processes an item has gone through. By doing this, RFID makes it possible to build an electronic pedigree (e-pedigree) of the product itself. This e-pedigree on the one hand certifies the quality of all the steps a product has gone through and, on the other one, can be leveraged to trace back single processes, in case defects or issues emerge.

3. Discussion and conclusions

The retailing sector has been boosting the RFID market in the last few years, since almost 75% of UHF tags manufactured are sold to this industry. Unofficial figures report that retailers have consumed as much as three billions tags in 2014, and we can say the this is just “scratching the surface”, since the top 50 retailers of the world hold a potential volume of 25 billion tags, while the total apparel market represents about 40 billion clothing and accessory items on a yearly basis.

One of the main reason behind these impressive numbers is that no industry can count so many use cases for RFID deployments as fashion and apparel retailing. In this paper, a novel and up to date frame of reference for classifying use cases of RFID deployments in fashion and apparel retail was presented. The objective of the paper was to complete, update and overcome the main limitations of previously published taxonomies, such as that proposed by (Moon and Ngai, 2008).

To achieve this goal, the paper starts with an introduction on the fashion and apparel retail industry, and it focuses the attention on the use of RFID within this context. To this extent, we carried out an extensive review of the literature on RFID applications in this sector, reviewing a total of 77 RFID projects out of 95 studies on RFID.

Each project was thoroughly analysed, and the use cases pursued by that specific project were used to elaborate this new frame of reference that categorizes use cases of RFID in fashion retailing. In our frame, level 0 indicates the fashion retailing context, level 1 indicates the scopes, or impact areas where RFID technology can be implemented, and level 2 reports and describes the specific use cases of RFID. Overall, we encompassed 6 level 1 use cases, and 18 level 2 use cases.

We believe our work can be relevant both for practitioners and academics. Practitioners, in fact, can find in our framework a support tool to validate their business purposes, or appraise the numerous benefits RFID deployments could lead to. Academics, on the other hand, could derive from this frame important information about new research spaces for RFID technology in the apparel and fashion industry. Interesting though it is, our work still presents some major limitations, such as:

- the frame we proposed was not yet validated from an industrial audience belonging to the fashion and apparel retail sector;
- the use cases we proposed still lack of clear examples that could greatly help to visualize and understand our frame of reference;
- after the database and use cases are validated, some preliminary statistics could greatly help to classify projects of RFID deployments in this industry according to their defining characteristics;
- apply the proposed framework in order to categorize real deployments, and correlate use cases with successful deployments;
- publish an open access data base of RFID projects so that literature on this topic can gain access to a comprehensive data set.

Indeed, the authors are working on some of these topics for upcoming research papers.

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5. References


