

## **Towards Standardizing Success: RFID in Fashion Retailing**

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### **Abstract**

During the last decade, many companies considered to implement RFID technology in their supply chains. They had to choose from a variety of largely incompatible RFID systems and therefore demanded RFID standardization. Only common RFID systems along the supply chain were expected to deliver the substantial benefits.

This paper describes the RFID pilot and roll-out by German fashion retailer Kaufhof and analyzes Kaufhof's role in the RFID standard-making process. It finds that (1) arguments concerning the RFID standard-making process partially deviate from the common public goods argument in the literature, (2) early involvement in standard-making mitigates a company's risk of future property right allegations, and (3) a third-party mediated standard-making process, rather than a vendor-promoted one, delivers feasible and compatible standards. The paper concludes with a summary and an outlook to future research.

**Keywords:** Standard-making, RFID, Case Study

### **1 Introduction**

Since the beginning of the millennium, Radio Frequency Identification (RFID) has been set to succeed barcode technology, which - upon standardization - had spread widely in retailing (Brown 1997). RFID has been expected to extend and intensify supply chain collaboration and thus to increase efficiency. However, early RFID pilots in fast moving consumer goods (Loebbecke 2004; Wilding, Delgado 2004) and fashion (McGinity 2004; Loebbecke, Palmer 2006) demonstrated that RFID standardization was still in its infancy, even though inevitable for success. Consequently, RFID user companies and technology vendors started to get involved in standard-making processes.

## **2 Literature Brief on Standard-Making**

Although standardization and impacts of standards had been under research in the past, Lyytinen and King (2006, 406) noticed "a lack in examining processes and factors that explain why and how such standards emerge and diffuse, or fail to do so". Picking up the standardization issue 'RFID' and the request for standard-making research, this paper investigates the RFID standard-making context given by EPCglobal and a retailer's related activities. The paper ends with a summary and an outlook to future research.

## **2 Literature Brief on Standard-Making**

Spivak and Bremer (2001, 16) define standards as "a uniform set of measures, agreements, conditions, or specifications between parties". This definition includes standards on multiple levels, i.e., infrastructure, business processes, and applications. Lyytinen and King (2006) indicate that guidance towards compatibility and interoperability drives standard-making.

Hawkins (1995) differentiates standards according to the regulatory scope as national or international. Gabel (1991) distinguishes proprietary standards, owned and governed by a single organization, from public domain agreements which make specifications public and allow for adaptations. Axelrod et al. (1995) and Hanseth and Monteiro (1997) suggest to distinguish de facto standards and de jure standards. De facto standards are created by technology vendors and not officially announced. De jure standards result from a pre-specified process by standard-making bodies such as the American National Standards Institute (ANSI) or the International Standard-Making Organization (ISO). Nickerson and zur Muehlen (2006) point to anticipatory standards which imply a proposal, revisions, and agreed upon specifications prior to putting them to practice.

Considering the standard-making process, Olson and Zeckhauser (1966) propose to apply the lessons from military alliances to standards and other institutional or economic settings. They argue that large players carry a disproportionately larger burden of standard-making expenses than small players. Besides varying efforts, Weiss and Cargill (1992) find that organizations involved in the standard-making process pursue different interests. Along those lines, Kindelberger (1983) and Markus et al. (2006) utilize collective action theory to investigate the contribution of different parties to standard-making processes. They point to the public good character of standards, which may imply free-rider behavior by some during the standard-making process.

Shapiro and Varian (1999) investigate the economics of network effects in case of more than one standard resulting from standard-making processes. They find that network effects often lead to standard wars with only one standard remaining in the market. Besen and Farrell (1994) in proprietary standards is intuitive, while the allocation of property rights with regard to public domain standards is difficult. Shurmer and Lea (1995) stress the dilemma which emerges from insufficient intellectual property rights governance by standard-making bodies.

Institutional theory targets the role of organizations in the standard-making process. In the respective body of literature, Damsgaard and Lyytinen (2001) analyze intermediaries such as standard-making bodies, whereas Garud et al. (2002) investigate promoters such as individual technology vendors in the

standard making process. Beck and Walgenbach (2003) explore the interplay of institutions in the standard-making process.

### **3 Research Methodology**

For our research, we utilized a single fieldwork case study and integrated perspectives from individual organizations, industry associations, and standard-making bodies. The exploratory, single fieldwork case study best reflected the complex setting involving multiple types of organizations with varying interests and incentives. It was well suited to approach an explanation of the 'how' in the standard-making process (Yin 1981; Yin 2003). The fieldwork ranked around the fashion retailer Kaufhof, a unit of METRO Group, the world's third largest retailer<sup>1</sup>.

We chose the fashion industry as a suitable setting, as it integrated several globally distributed parties. Retailers were powerful players in the fashion supply chain. Kaufhof was an innovator in the fashion industry. It experienced the first generation of RFID standardization, contributed to the main infrastructure standards, and initiated the industry-specific business process standardization.

Data collection comprised several sources and mainly qualitative data. We reviewed publicly available sources and collected data from Kaufhof, its supply chain partners, and standard-making organizations between 2003 and 2007. We conducted repeated interviews with the managing director of METRO Group Information Technology (MGI)<sup>2</sup>, a Kaufhof senior logistics manager, a Kaufhof manager responsible for all RFID related projects, a director of GS1-Germany<sup>3</sup>, and a board member of the EPCglobal<sup>4</sup> 'Apparel, Fashion & Footwear Business Action Group'. Semi-structured interviews emphasized the necessity of standards and standard-making for infrastructure, business processes, and applications. Meeting minutes complemented the understanding of phenomena beyond direct observation. Finally, IT managers and CIOs of fashion manufacturers on RFID contributed their perspectives on RFID standardization in fashion during a fashion industry event.

### **4 Standard-Making and Kaufhof's RFID Project**

Since the mid-1990s increasing competition has put pressure on wholesale and retail prices and has changed the fashion industry (WIPO Magazine 2005). The industry has faced as many as fourteen fashion cycles per year. Fashion manufacturers and retailers have reacted to the challenges and increasingly considered the implementation of RFID in the supply chain. For their merchandize of varying price, packaging, and trends, they have aimed at process and customer service improvements (Kurt Salmon Associates 2005) along the

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1 Kaufhof generates about half of its €3.6 billion turnover in the fashion sector.

2 METRO Group Information Technology is a shared services department of METRO Group developing the RFID strategy and executing it throughout METRO Group's units

3 GS1-Germany ([www.gs1-germany.de](http://www.gs1-germany.de)) is a national chapter of the international non-profit organization GS1 that supports infrastructure and business process standardization in numerous industries.

4 EPCglobal ([www.epcglobalinc.org](http://www.epcglobalinc.org)) is an international standard-making organization concerned with RFID.

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multi-tier fashion supply chain with manufacturers, distributors, and retailers. 'Vendor managed inventory' and 'seasonless' retailing have been barely feasible as supply chain members have not shared sufficient data.

### 4.1 The Kaufhof-Gerry Weber RFID Pilot

When Kaufhof considered the implementation of RFID, it initiated an inter-organizational RFID pilot with Gerry Weber<sup>5</sup>. The pilot ran from July 1 to November 30, 2003 (e.g., METRO Group 2005; Loebbecke, Palmer 2006). The main goal of the project was to test the practical viability of RFID in everyday business (Kanzok 2004). The project aimed at investigating (1) potential RFID-based efficiency improvements resulting from accelerating and simplifying supply chain workflows, (2) potential shrinkage reductions and productivity increases through asset tracking, and (3) overall RFID profitability.

For the pilot, Kaufhof and Gerry Weber first had to decide which RFID frequency to use. They could select between the available high frequency<sup>6</sup> (HF) and ultra-high frequency<sup>7</sup> (UHF) bands. In 2003, the International Standard-Making Organization had only standardized high frequency (HF) for both, unit and item level. So Kaufhof and Gerry Weber selected high frequency (HF) for unit and item level in spite of some limitations regarding long field readings; cost reasons forbade redundant set ups for high frequency (HF) and ultra-high frequency (UHF).

As identifier on the tag, Kaufhof and Gerry Weber used a combination of the standardized European Article Number (EAN) and proprietary product codes. The standardization of the Electronic Product Code (EPC) was still ongoing.

In the pilot, Gerry Weber shipped merchandize from its production facilities via logistics service provider Meyer & Meyer to a Kaufhof distribution centre. Kaufhof then distributed the merchandize to two selected stores. Gerry Weber and Kaufhof tested RFID in the full range of processes along the supply chain, from production, to tagging items and units, various controls of incoming and outgoing goods, tracking and localization, inventory management, shelf management, theft prevention, and checkout.

Kaufhof and Gerry Weber experimented how the reading rates varied with materials, transponders proximity, and speed and number of products traveling through RFID gates (Loebbecke et al. 2006). The pilot indicated the technical feasibility of RFID implementations along the fashion supply chain. It proved RFID reading accuracy to be more than 99% even under real-life circumstances. Further, it promised efficiency gains from enhancing supply chain processes, e.g. more precise and faster inventory management (Kanzok 2006) and sales increases through better customer service (Loebbecke, Palmer 2006).

Before extending the pilot to roll-out, however, Kaufhof raised concerns regarding transponder costs, readability, and compatibility. It participated in standard-making initiatives working towards a common solution to those issues and decided to pursue the RFID roll-out rather in phases than all at once.

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5 Gerry Weber International AG is a German fashion and lifestyle company. In its 800 shops, Gerry Weber in 2005 generated sales of about €400 million and 8% EBIT margin with a workforce of almost 1,700.

6 HF refers to 13.56 MHz frequency, as used by Kaufhof, not the entire HF band.

7 UHF refers to the 868 MHz frequency used by METRO Group and Kaufhof, and not the entire UHF band.

## 4.2 Kaufhof's RFID Roll-Out on Unit Level

In February 2004, after positive experiences in the Kaufhof-Gerry Weber pilot, METRO Group Information Technology, a METRO Group shared services department, suggested to roll-out RFID on logistic units. At the beginning, METRO Group Information Technology recommendation concerned two of METRO groups six sales division, namely Kaufhof and Metro Cash & Carry.

Thereupon in November 2004, Kaufhof implemented RFID also in its regional distribution center in Neuss. In the following eight months it equipped also four more distribution centers. It reconfigured the business processes in the distribution centers so that they could automatically count incoming and outgoing goods.

While Kaufhof had utilized high frequency (HF) RFID in its pilot, METRO Group and its competitor Wal-Mart had worked with ultra-high frequency (UHF) in early unit-level RFID operations. Different frequencies were challenging for METRO Group and the other players in the fashion supply chain though.

METRO Group, Kaufhof, Wal-Mart, and others engaged in EPCglobal, an international non-profit organization, comprised of more than 750 companies and Auto-ID labs at universities. EPCglobal had emerged as a joint venture of GS1, formerly the European Article Numbering (EAN), and its US counterpart GS1 US, formerly the Uniform Code Council (UCC). EPCglobal aimed at globally harmonizing product numbering and infrastructure to ease worldwide supply chain management.

As of 2003, METRO Group Chairman and CEO Koerber had represented METRO Group on the EPCglobal board. Seeing the need for a globally standardized product coding scheme, he had emphasized METRO Group' support for standardizing the EPC as global standard. With METRO Group and Wal-Mart, at least two retailers promoted one standard on the EPC Board.

In 2004, METRO Group CIO Mierdorf followed Koerber on the EPCglobal board. He also became member of the GS1 board. Similar to Koerber, Mierdorf pursued developing, promoting, and governing international RFID standards in the supply chain.

EPCglobal aimed at facilitating an effective standard-making process. It designed a policy framework with four main policies, (1) intellectual property right policy, the (2) good standing policy, the (3) consensus policy, and (4) the fair use policy.

*Intellectual property right policy:* EPC members signed a declaration to avoid "blocking proprietary claims or monopolization of use of the specifications" (EPCglobal 2006, 63). They agreed to (1) disclose any intellectual property rights they were aware of concerning the specification under review and (2) grant licenses on fair conditions if intellectual property rights were touched (Behrens 2007).

*Good standing policy:* For each standard-making process, several EPCglobal members agreed to contribute in working groups and committees. As contributors those members had access to all process related information including definitions and specifications. To remain in good standing according to the PDC policy, contributing members had to participate actively and to attend meetings, workshops, and teleconferences. Members infringing the good standing policy were publicly blacklisted by EPCglobal.

*Consensus policy:* The EPCglobal consensus policy required consensus, but not unanimity in order avoid blocking of important standards due to individual interests. Thus it took account of the diverse interests among members.

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*Fair use policy:* The fair use policy demanded that the resulting EPCglobal standards would be open and licensable on fair conditions by any organization. It implied in advance not to exclude outsiders from standards use.

After about one-year RFID standard-making activities, EPCglobal approved the Generation II (Gen II) standard in December 2004. Gen II specified an ultra-high frequency (UHF) range. Thus it eased collaboration among international supply chain partners -and refrained Kaufhof from using or supporting high frequency (HF) any longer (Loebbecke, Huyskens 2006).

Following an internal debate over a switch to Gen II, in March 2005 METRO Group's Information Technology unit conducted lab trials in its Innovation Center in Neuss, Germany. Taking into account performance measures and downward compatibility, METRO Group decided for a group-wide adoption of Gen II for RFID on unit level.

Kaufhof then followed METRO Group in the decision for Gen II, even though Gen II did not operate with the high frequency (HF) transponders used in the pilot.

#### **4.3 Towards Kaufhof's RFID Roll-Out on Item Level**

Encouraged by positive experiences and growing standardization, Kaufhof began to approach RFID on item-level. The plan to tag about 70 million textile items per year raised the tag cost issue. The affordability threshold of €0.10 for each transponder was not yet achieved (Kanzok 2004), even though the cost for the entire price label had decreased substantially from about €0.40 in 2003 to about €0.15 in October 2006. It seemed that the industry was close to making item level roll-out economically feasible for fashion goods (Kanzok 2006).

Also, Weber pilot, transponder readability had improved since the Kaufhof-Gerry for two main reasons: (1) In early 2005, European regulators allowed for stronger energizing ultra-high frequency (UHF) equipment and thus facilitated tag reading over wider ranges. (2) In June 2006, for the first time technology vendor Impinj Inc. presented fashion-specific RFID systems capable of reliable near and long-field reading. The new technology permitted ongoing utilization of existing equipment.

While METRO Group engaged in RFID standardization across industries, Kaufhof focused on the fashion industry and contributed to standardizing RFID data transfers and processes in the fashion industry. Kaufhof considered such fashion specific standards necessary for item-level RFID roll-out. It expected fashion specific standards to enable players to monitor not only the number of blouses in inventory, but also their respective colors and sizes.

In May 2006 Kaufhof co-initiated the EPCglobal 'Apparel, Fashion & Footwear Business Action Group' in preparation for item-level roll-out. With Kaufhof's RFID project manager Quiede on the board of the 'Apparel, Fashion & Footwear Business Action Group', Kaufhof actively engaged in RFID standard-making on item level. It supported identifying business needs, gathering business requirements, and developing consensus on best practices (EPCglobal 2006). Kaufhof investigated item-level RFID at selected men's wear departments; it tested specifications evolving in the standard-making process. With the tests, Kaufhof set the base for another round of reviews in the standard-making process before final ratification by the EPCglobal board. At the end of 2006, after Gen II standard ratification, Kaufhof finally considered to roll-out item-level RFID.

#### 4.4 RFID Diffusion in the Fashion Supply Chain

Working towards extending RFID to the entire supply chain, Kaufhof increasingly approached fashion manufacturers. Between December 2004 and June 2005, Kaufhof invited the fashion manufacturers Gerry Weber, Esprit, and Triumph to participate in unit-level RFID roll-out. Together they applied RFID in the supply chain to perform (1) the check-out of units from the manufacturer, (2) the check-in at Kaufhof's distribution centers, and (3) 'cross-docking' where suppliers' shipments to distribution centers were directly – without any further storing – repackaged to orders and further distributed towards recipients. To guarantee operational inter-organizational processes, Kaufhof and the other players kept barcodes in use as a backup.

Kaufhof had originally anticipated manufacturers to only reluctantly adopt RFID due to costs and required know-how. To its surprise, several manufacturers rushed forward with RFID, even before infrastructure standards were ratified. For a while, some manufacturers successfully continued traditional, with Gen II incompatible high frequency (HF) equipment, while Kaufhof's initial RFID partners, Gerry Weber, Esprit, and Triumph, switched to Gen II on ultra-high frequency (UHF) upon availability after ratification. In September 2006, Kaufhof, competing retailers and various manufacturers had managed to establish an end-to-end RFID logistics infrastructure and to apply various supply chain applications of RFID in.

### 5 Discussion of Standard-Making

METRO Group and Kaufhof, through EPCglobal and GS1, actively participated in international RFID standard-making, a process mostly driven by EPCglobal and GS1 member organizations in search for supply chain interoperability and enhanced efficiency.

#### 5.1 Resulting in De Facto or De Jure Standards?

With EPCglobal, a private intermediate non-profit organization governed the standard-making. The RFID standard-making process comprised both private interests of participating EPCglobal members and public domain objectives of licensable standards (Cargill 1997; Schoechle 2003). EPCglobal as standard-making consortium integrated the divergent interest aiming for standards serving the public domain. It made the specifications publicly available and allowed for adaptations following a formal process. One could consider the RFID standards *public domain standards*<sup>8</sup>, if one refers to the openness of the standard-making process and the availability of the resulting standard specifications.

Public domain standards could shape up as either *de jure* or *de facto* standards. De jure standards would have to follow a formal and open proposal, review, ratification, and announcement process organized by a standard-issuing organization. De facto standards would emerge from the market dominating technology, provided by either an individual technology vendor or a vendor alliance.

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8 Public domain standards are not to be confused with public domain property rights.

## **5 Discussion of Standard-Making**

The network effects in RFID standardization could suggest classifying the RFID standards as de facto. If one technology vendor or an alliance of technology vendors built and maintained a large installed base, it could subsequently issue a de facto standard (David, Greenstein 1990). But in the case of RFID standard-making, no individual vendor or vendor alliance appeared to have a large enough installed base. So, the RFID standard making process did not result in any de facto RFID standard.

RFID standard-making followed an open and formal process including a collective proposal, a review, and ratification (Verdegem, Slats 2004). Only in case one considers EPCglobal a standard issuing authority, the RFID standards would be classified as de jure. But EPCglobal was just a standard preparing organization, while the International Organization for Standardization was the standard issuing authority. So, the RFID standard making process did not result in any de jure standard either.

But EPCglobal prepared the later successful ratification by International Standard-Making Organization. Further, the RFID standards resulting from the processes described and analyzed above led to several important implications common to 'de jure' standards.

EPCglobal treated the RFID standards as de jure ones. Based on its fair use policy, EPCglobal granted licenses to the public on fair terms and aimed at counteracting potential antitrust regulation (Shapiro 1998). Inviting everybody to use the licensed standards increased competition among standard users and at the same time eliminated competition for the actual standards (Besen, Farrell 1994). Standard wars could not emerge (Shapiro, Varian 1999).

### **5.2 Leading to Standards as Public Goods?**

The public good argument (e.g., Demsetz 1970) common in standards discussions (e.g., Tassef 2000) is important to various players. Characteristics of public goods discourage investments and engagements in their private production based on the arguments of free-riding and negative externalities (Kim, Walker 1984).

EPCglobal members had access to standardization information and in exchange were asked to actively contribute on various levels of the decision process. To keep members from only passively benefiting from the information, EPCglobal enforced its good standing policy and threatened public denunciation of free-riders. For actively contributing members, EPCglobal with its good standing policy lowered the risk of others choosing the free-rider path. It effectively counteracted emerging free-riding and thereby demonstrated that private production of public goods such as standards was feasible.

The public good character of RFID standards also raises the concerns that large players contribute a disproportionate burden of the efforts needed for private production (Olson, Zeckhauser 1966).

The engagement of the large players METRO Group and Kaufhof certainly confirmed the disproportionate burden. METRO Group and Kaufhof disproportionate contribution to the standard-making process included personal commitment and the running of technology trials. However, beyond the argument of the disproportionate burden, METRO Group and Kaufhof regarded their efforts as investment in shaping the future of their supply chains. They appreciated that early influencing standard specifications assured that they could align their business processes with the standard requirements.

As large players, METRO Group and Kaufhof also disposed of the necessary deep pockets needed to follow a long-term strategy and exploit their experience and respect as RFID innovators (see Future Store Trial, e.g., Loebbecke 2004 or Kaufhof-Gerry Weber Pilot, e.g., Loebbecke, Palmer 2006).

Other large retailers, however, did not join EPCglobal. They pursued the public good argument more directly and chose the free-rider option (Sternberg 1996). In their view, the required long term investments in RFID were not compatible with capital market demands and anticipated negative externalities to occur for standard-making contributors. Hence, they expected to take advantage as late movers and thus to reap the major standard rewards.

### **5.3 Securing Intellectual Property Rights?**

To protect EPCglobal members and the targeted RFID standards, EPCglobal's intellectual property policy and the consensus decision policy accounted for the hazard of property rights residing with individual member companies. The policies encouraged members not to block standard-making and helped them to avoid paying unexpected post-standardization royalties (Snow 1994). They fostered the legal certainty for users of EPCglobal RFID standards.

Nevertheless members were concerned that EPCglobal outsiders could block the standards or demand royalties by claiming property rights touched by the proposed standard specifications. Therefore EPCglobal members - through the consortium - asked patent attorneys to search for potential limitations during the standard-making process. If such limitations were found, EPCglobal members tried to integrate the property right holding outsiders in the EPCglobal standard-making process. If they failed, EPCglobal would withdraw the standard proposal and cancel the specific standard-making process.

## **6 Summary and Outlook to Future Research**

This paper described and analyzed RFID standard-making along Kaufhof's RFID project in the fashion supply chain - from pilot to roll-out on logistic units and items. Kaufhof and its parent METRO Group actively contributed to EPCglobal and GS1, jointly working with both groups towards user-driven standard-making concerning infrastructure, numbering, and business process standards. The paper analyzed Kaufhof's activities under the given EPCglobal framework of standard-making policies, which aimed at guaranteeing access to the standards, counteracting possible free-riding, and assuring sensible handling of intellectual property rights issues. It found strategic and economic arguments for METRO Group and Kaufhof as large players, respected as technological innovators to carry a disproportionate burden in developing quasi public goods - RFID standards.

Future research could evaluate the private interests of the parties involved in standard-making more in depth. Further, a broader base of companies involved in standard-making could provide data for confirming some of the initial findings. Finally, future research could assess the outcomes of having participated in the standard-making process, both from an individual player's perspective and considering overall supply chain efficiency. It could investigate whether to confirm the public good argument of successful free riders that adopt technology

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late or provide further support for the argument of well calculated investments to exercise influence on standard-making.

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