23 RFID ADOPTION: Theoretical Concepts and Their Practical Application in Fashion

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Abstract *Technology vendors increasingly praised RFID technology to improve tracking and replenishment in supply chain management (Vervest et al. 2004). Many companies, especially retailers, announced plans for quick RFID adoption. Despite obvious technology advantages, RFID adoption made only little progress in today's supply chains. This paper explores the discrepancy between RFID announcements and reality. From a literature review, the paper derives three theoretical concepts and ten associated factors of organizational technology adoption and diffusion. It then describes the RFID adoption by a fashion retailer that started with an RFID pilot and stretched the RFID roll-out process over several stages. In the description, the paper also briefly touches upon RFID diffusion in the fashion supply chain. Finally, the paper discusses to what extent each of the ten factors derived from the literature apply to RFID adoption and diffusion in the fashion industry. It discovers some factors, crucial for adoption and diffusion and others which play only a minor role. The paper closes with some conclusions and suggestions for further research.*

Keywords Organizational technology adoption and diffusion, RFID, fashion industry, case study

1 INTRODUCTION

Since World War II, radio frequency identification (RFID) technology has been used for varying purposes ranging from detection of hostile warplanes to highway toll collection (Landt 2005).

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The U.S. Department of Defense announced in the early 1990s that RFID technology held the potential to revolutionize "In-Transit-Visibility" and the "Total Asset Visibility" in supply chains (Kolleda 2005). The DoD's subsequent support for the technology encouraged many technology vendors to also push forward RFID development for commercial purposes (Liard 2003).

However, the value of RFID technology for managing business supply chains has only been recognized in recent years. The business press has since proclaimed that RFID marks a commercial innovation with the potential to soon replace barcode technology in the supply chains of numerous industries (*The Economist* 2003).

Incited by those developments and promises, companies from varying industries planned RFID adoption aiming to exploit cost saving potentials and new business opportunities (McGinity 2004). Early press releases by companies, such as METRO Group, Wal-Mart, and Tesco, outlined ambitious timelines for the implementation of RFID along their entire supply chains (Collins 2006).

However, several years after the first releases, very few projects have been completed, indicating that the process of RFID adoption and diffusion along supply chains is more complex than generally anticipated.

This paper attempts to clarify how the process of RFID adoption by companies and industry diffusion occurs and which factors are relevant in the process. It proceeds with a methodological argument for the case study approach for analyzing organizational adoption and industry diffusion issues. A review of the theoretical underpinnings of organizational adoption and diffusion of technology fuels the selection of theoretical concepts and associated factors for analyzing RFID adoption and diffusion. The paper describes the RFID adoption at Kaufhof Department Stores AG (Kaufhof), a German fashion retailer and subsidiary of METRO Group, and the RFID diffusion along the fashion supply chain. The discussion investigates to what extent existing theory on technology adoption and diffusion corresponds with the observed actions taken by Kaufhof and in the fashion industry. The paper closes with some conclusions and an outlook to future research.

2 RESEARCH METHODOLOGY

This paper utilizes a three stage research strategy to investigate the process of organizational RFID adoption by Kaufhof and RFID diffusion in the fashion industry.

In the quest for theoretical guidelines to set up a research design, we drew on the technology adoption and diffusion literature (see section 3). A longitudinal single fieldwork case study served as research method in order to adequately reflect the complexity of reality in an approach to explain the "how" in the technology adoption and diffusion process (Galliers 1992; Yin 2003). According to Yin's (1981) case study typology, this paper stresses the exploratory character.

In a second stage, we collected mainly qualitative data in the field. We gathered data from Kaufhof and its supply chain partners during the entire project between 2003 and 2006. In particular, we conducted semi-structured interviews with senior executives and project managers. The interviewees included a Kaufhof manager in charge of logistics, a Kaufhof manager heading all RFID related projects, and the managing director of METRO Group Information Technology. The interviews covered the overall adoption

process. The questions emphasized participating organizations and their objectives, the measurement of fulfillment, and the respective implementation stage and schedule. During an industry event on RFID, we also acquired insights from IT managers and CIOs of fashion manufacturers regarding their RFID projects.

Additional data collection efforts involved publicly available company and market data (Benbasat et al. 1987). Minutes of meetings provided information concerning inter-organizational events not allowing direct observation. Financial reports added to the information base as they provided information on the project context, objectified measures, and official objectives tied to the adoption of RFID technology.

Ongoing data collection during the entire duration of the project assured the inclusion of management perspectives prior to project launch, during the pilot, and during the roll-out. The informal interview settings gave respondents the opportunity to be frank about their perceptions and impressions of the project. Reviewing results for inconsistencies and ambiguities and, if necessary, rechecking with interviewees reduced the risk of misconceptions. Finally, we presented the final case to METRO Group and Kaufhof executives to be corrected in terms of factual content.

In a third stage, we analyzed to what extent the theoretical arguments selected from the organizational technology adoption and diffusion literature corresponded with the RFID adoption and diffusion experiences gathered by Kaufhof and the fashion industry.

Admittedly, the single case study method lacks some generalizability compared to multiple cases or quantitative cross-sectional methods. However, the more appropriate representation of the adoption and diffusion processes weighs against that weakness.

3 THEORETICAL FOUNDATIONS: ORGANIZATIONAL TECHNOLOGY ADOPTION AND DIFFUSION

Rogers and Shoemaker (1971, p. 154) define adoption of innovations in general as "the relative speed with which an innovation is adopted by members of a social system." More specifically, Agarwal et al. (1997, p. 347) define organizational adoption of IS as the "first successful system using a new information processing technology." The information system may be used for either a product or an internal process.

Rooted in the field of social psychology, Fishbein and Ajzen (1975) with their theory of reasoned action (TRA) offer a marketing-oriented theoretical starting point for explaining customer adoption. Following TRA, individuals exhibit attitudes and conform to subjective norms. A combination of those elements determines the behavioral intention of individuals, which in turn causes behavior.

Davis, Bagozzi, and Warshaw (1989) employ the underlying argument of TRA and adapt the model to technology by proposing a technology acceptance model (TAM). Their main contribution lies in proposing perceived usefulness and perceived ease of use as concrete individual perceptions that replace the abstract beliefs forming attitudes in TRA. However, Bagozzi, Davis, and Warshaw (1992, p. 664) limit the causal structure of their model, indicating that "actual usage may not be a direct or immediate consequence," especially in case of problematic objects of behavior (e.g., adoption of specific software applications). Owing to this, Venkatesh and Davis (2000) later refine the model integrating social influence by third parties and cognitive processes by the individual into

TAM2. Applications of TAM2 include mandatory adoption contexts abstracting from free will, an assumption of TRA and TAM. However, TAM and TAM2 build on behavioral assumptions intended for individual adoption rather than contexts of organizational adoption.

According to Brown et al. (2002), in organizational contexts behavioral arguments exert less influence on actual adoption than in individual settings. Karahanna, Straub, and Chervany (1999) show that different drivers determine the adoption intentions of technology users and organizational adopters. For example, attitudes determine users' intentions with regard to adopting Windows in organizations, while normative pressure determines the intentions of actual organizational decision makers.

Institutional theories offer another research stream to explain organizational adoption and diffusion of technology. Zmud (1984) and Cooper and Zmud (1990) argue that rational organizational adoption decisions aim primarily at organizational goal achievement, which implies the subordinate objective of technological efficiency as technology adoption driver. This argument is in line with the finding of Brown et al. that organizational perception of usefulness differs from that of individuals (i.e., it relates to efficiency as opposed to individual goal achievement and satisfaction).

Resource dependency theories (Pfeffer and Salancik 1978) offer arguments concerning the power over resources. They are especially applicable, as supply chain contexts require technology adoption by all involved companies. Iacovou, Benbasat, and Dexter (1995) consider the existence of resources (e.g., IT sophistication) to determine organizational readiness for technology adoption. Small organizations often have fewer IT resources. In their resource dependency argument, Hart and Saunders (1997) indicate that interorganizational relationships comprise stronger and weaker partners with regard to resource allocation. They conclude that stronger organizations may drive the adoption of interorganizational technologies, while weaker organizations can only comply with adoption.

Westphal, Shortell, and Gulati (1997) and Konsynski and Tiwana (2004) identify either problem solving or the creation of business opportunity as a trigger for the adoption of total quality management, especially in interorganizational networks.

Overall, the different theoretical streams offer three groups of factors affecting organizational adoption: *external influences*, *perceived organizational benefits*, and *organizational characteristics* (Matta and Moberg 2006). Table 1 illustrates the three categories involving a total of ten factors influencing organizational technology adoption and diffusion.

3.1 External Influences

In the supply chain context, organizations adopt a technology or even a specific information system either due to coercive power imposed by a dominant organization (Iacovou et al. 1995; Jeyaraj et al. 2006) or based on free will (Moore and Benbasat 1991). The coercive power exerted by dominant companies has played a role in the adoption of electronic data interchange (EDI) in the supply chain (Hart and Saunders 1997; Premkumar 2000; Webster 1995) and in the adoption by electronic trading communities (Allen et al. 2000; Gerst and Bunduchi 2005). Depending on the supply chain, the question of which player has a dominant position varies from manufacturers in the automotive in-

***Table 1*. Factors Influencing Organizational Technology Adoption and Diffusion**

Concept	Factor
External Influences	Coercive Pressure
	Isomorphic Pressure
	Information Availability
Perceived Organizational Benefits	Integration Efforts
	Standards Availability
	Quality of Service
	Financial Benefits
Organizational Characteristics	IT Commitment
	Top Management Support
	Organizational Size

dustry (Gerst and Bunduchi 2005), to wholesalers in pharmaceuticals (Naert and Swinnen 1977), and to retailers in fast moving consumer goods (Loebbecke 2004).

Adoption of innovative technologies exerts pressure on industry peers to follow the adoption. Such isomorphic pressure is exercised by capital markets (DiMaggio and Powell 1983; Haunschild and Miner 1997) and has been found in the context of adopting enterprise resource planning systems (Benders et al. 2006). Isomorphic pressure naturally threatens competitive advantages acquired by early movers (Clemons and Wang 2000).

Further, information availability on potentially relevant technology matters to potential adopters (Jeyaraj et al. 2006; Matta and Moberg 2006). Not only information on the existence of technology, but also information on potential solutions and the availability of adaptation and implementation know-how drive adoption. Concerning interorganizational relationships, information availability plays a role in EDI adoption (Walton and Gupta 1999; Shah et al. 2002) and in adoption of electronic markets by organizations (Dai 2002).

3.2 Perceived Organizational Benefits

Adoption of innovative IS along the supply chain and across interorganizational interfaces requires stronger integration efforts than IS adoption in intra-organizational environments (Iskandar et al. 2001; Briggs et al. 2003). McKeen and Smith (2002) investigate such adoption-related integration efforts in the context of enterprise application integration, Lee and Sohn (2003) concerning electronic marketplaces, and McLaren, Head, and Yuan (2002) with regard to EDI.

The availability of standards influences adoption because standards reduce the integration risk of multiple technological solutions implemented in a supply chain (Church and Gandal 1993; Kauffman and Techatassanasoontorn 2005). With regard to interorganizational information systems, EDI standards (Chwelos et al. 2001; Markus et al. 2006), standards for electronic marketplaces (Christiaanse and Markus 2003), and web services standards (Chen 2003) are relevant in adoption decisions.

Process innovations often build on preexisting systems. Therefore, they need to deliver comparable quality of service, avoiding interruptions or delays in the flow of information (Pitt et al. 1995; Watson et al. 1998). Insufficient service quality has a negative influence on adoption (Pitt et al. 1995). For instance, quality of service influences EDI adoption and diffusion due to its effect on performance (Ramamurthy et al. 1999).

Financial benefits, determined by the return on initial investments and the required operating costs, add to perceived organizational benefits (Eastin 2002; Matta and Moberg 2006).

3.3 Organizational Characteristics

Organizational IT commitment and top management support influence organizational adoption of innovative information systems (Cooper and Zmud 1990; Karahanna et al. 1999) as studied in the contexts of EDI (Premkumar et al. 1997), e-procurement technologies (Kauffman and Mohtadi 2004), electronic market platforms (Thatcher and Foster 2002), and open systems (Chau and Tam 1997).

Organizational size influences the adoption based on larger technology budgets and technological know-how (Kimberly and Evanisko 1981; Lai and Guynes 1997). Organizational size was found to be an adoption determinant for EDI (Iskandar et al. 2001; Premkumar et al. 1997), open systems (Chau and Tam 1997), and electronic markets (Palmer 2004).

4 RFID ADOPTION AT KAUFHOF AND DIFFUSION IN THE FASHION INDUSTRY

For more than a decade, increasing competition in the fashion industry put pressure on wholesale and retail prices and consequently on margins (*WIPO Magazine* 2005). The number of fashion cycles grew from 4 to 14 per year. Fashion manufacturers and retailers reacted to the challenges by increasingly considering innovative supply chain technologies such as RFID, without yet adopting them. They aimed at process and customer service improvements (Kurt Salmon Associates 2005). The multi-tier fashion supply chain comprised manufacturers, distributors, and retailers. It involved merchandise of varying price, packaging, and trends. Vendor managed inventory and seasonless retailing were barely feasible as supply chain members did not share sufficient data.

The following case covers RFID adoption at the department store chain Kaufhof (see also Loebbecke and Huyskens 2006) and describes the diffusion of RFID in the fashion industry (see Table 2 for the organizations involved and Figure 1 for the timeline of the Kaufhof RFID project).

In 2005, Kaufhof, a subsidiary of the world's third largest retailer, METRO Group, earned €69.2 million (1.92 percent operating margin). With 19,500 employees, it served more than two million customers who visited its more than 140 stores every day (METRO Group 2005). Kaufhof generated about half of its €3.6 billion turnover in the fashion sector.

Table 2. **Organizations and Their Functions in the Kaufhof RFID Project**

Organization	Function
METRO Group	Retailer
Kaufhof	Retailer
Gerry Weber	Manufacturer
Esprit	Manufacturer
Triumph	Manufacturer
METRO Group Information Technology	Shared services
EPCglobal	Industry association
GS1	Industry association
Impinj Inc.	Technology vendor

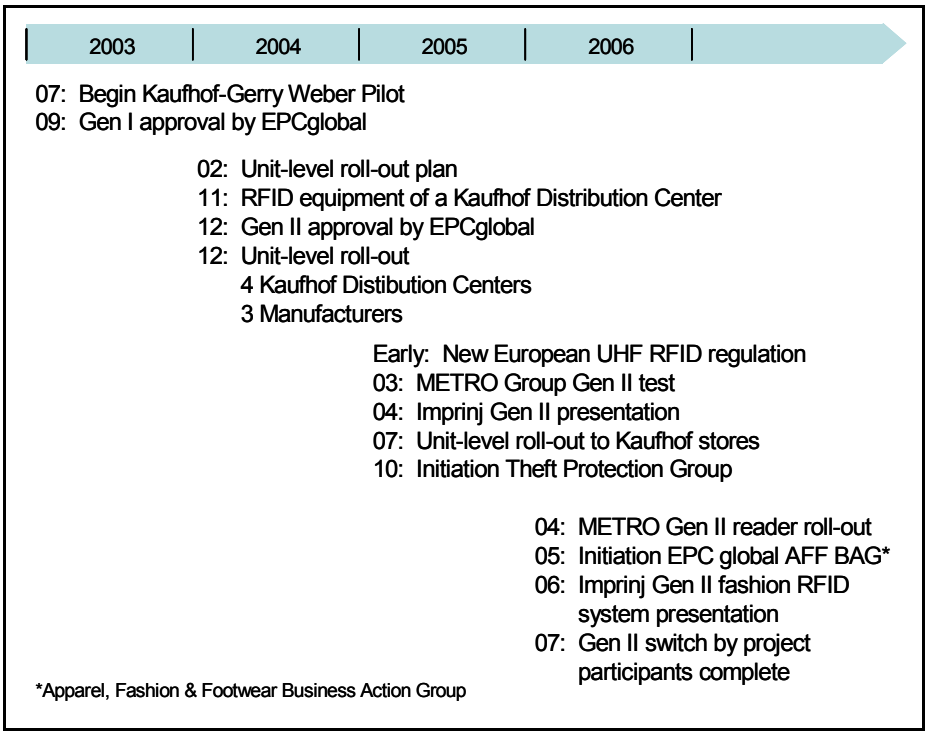

Figure 1. **Timeline of Kaufhof's RFID Project**

4.1 The Kaufhof–Gerry Weber RFID Pilot

As Kaufhof considered a potential RFID adoption, it initiated an interorganizational RFID pilot with Gerry Weber[1] in July 2003 (Loebbecke and Palmer 2006). According to Wilfried Kanzok (2004), Head of Logistics Central Functions at Kaufhof, the main goal of the project running between July 1 and November 30, 2003 (see also METRO Group 2005), was to test the practical viability of RFID in everyday business. In detail, the project aimed at (1) investigating the efficiency improvement potential through RFID by accelerating and simplifying supply chain workflows, (2) analyzing the RFID potential for reducing supply chain shrinkage and increasing productivity through asset tracking, and (3) assessing the overall profitability of RFID investments.

Before approaching those objectives, Kaufhof and Gerry Weber had to make a decision with regard to the RFID *frequency*. Parallel utilization of the two available frequencies—high frequency (HF)[2] and ultra high frequency (UHF)[3]—would have implied redundant sets of equipment. In 2003, the International Standardization Organization (ISO) standardized only HF for unit level and for item level. Therefore, Kaufhof and Gerry Weber selected HF for both levels, even though the decision brought some limitations, such as shorter reading range. Hence, with the METRO Group RFID roll-out in November 2004, Kaufhof also used UHF for logistic units.

In the pilot, Gerry Weber shipped all of its merchandise contained in the Kaufhof product assortment from its production facilities via logistics service provider Meyer & Meyer to a Kaufhof distribution center. Kaufhof then distributed the merchandise to two selected stores. Gerry Weber and Kaufhof tested the full range of processes along the supply chain, from production, to tagging items and units,[4] various controls of incoming and outgoing goods, tracking and localization, inventory management, shelf management, theft prevention, and checkout (see Figure 2).

In order to assess the general suitability of RFID, Kaufhof and Gerry Weber tested how the reading rates varied with materials, transponder proximity, and speed and number of products traveling through RFID gates.

As a result, the Kaufhof–Gerry Weber pilot indicated the technical feasibility of RFID implementations along the fashion supply chain. It proved RFID reading accuracy to be more than 99 percent even under real-life circumstances. It further promised efficiency gains from enhancing supply chain processes, for example, more precise and faster inventory management (Kanzok 2006) and sales increases through better customer service (Loebbecke and Palmer 2006).

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

[2]HF in this context refers to 13.56 MHz frequency, as used by Kaufhof, not to the entire HF band.

[3]UHF here refers to the 868 MHz frequency used by METRO Group and Kaufhof, and not to the entire UHF band.

[4]As key RFID code identifier on the tag Kaufhof and Gerry Weber used standardized European Article Number (EAN) along with proprietary product codes.

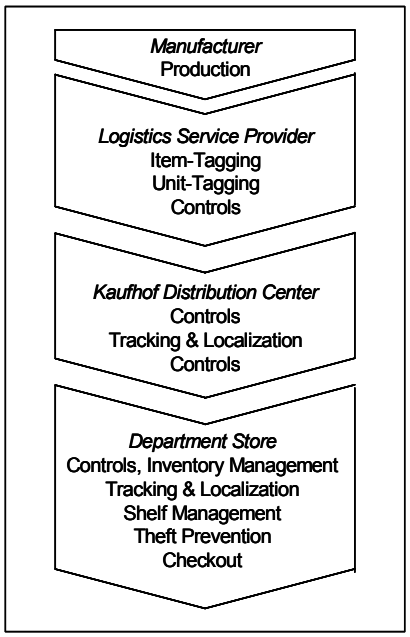

Figure 2. **RFID Supply Chain Stages and Processes in the Kaufhof–Gerry Weber Pilot**

However, the pilot also raised concerns regarding transponder costs, readability, and standardization. Kaufhof opted to participate in initiatives to solve those issues and to continue to adopt RFID on a small and manageable scale in order to pursue RFID roll-out in phases rather than opting for an immediate full-scale implementation.

4.2 Kaufhof's RFID Adoption on Unit Level

In February 2004, METRO Group Information Technology, a METRO Group shared services department, crafted a plan to adopt RFID on logistic units destined for Kaufhof and Metro Cash & Carry.[5] Experiences from the METRO Group Future Store supermarket and the Kaufhof-Gerry Weber pilot along the fashion supply chain informed and justified the decision by METRO Group's board.

As a consequence of the executive decision, Kaufhof continued its RFID implementation in the regional distribution center in Neuss in November 2004.[6] Over a period of eight months, Kaufhof equipped four additional distribution centers. It reconfigured

[5]METRO Cash & Carry, a sales division of METRO Group, operates wholesale markets.

[6]The Kaufhof distribution center, entirely equipped with RFID technology, had already been the lynchpin in delivery to the METRO Group's Future Store supermarket (Loebbecke 2004) and in the Kaufhof–Gerry Weber pilot.

associated business processes, which no longer required manual counts of outgoing or incoming goods.

While Kaufhof had utilized HF RFID in its pilot, METRO Group and Wal-Mart focused on UHF for their unit-level RFID operations. Varying frequencies among RFID systems were challenging not only within METRO Group, but also along a multi-tier fashion supply chain. Looking for a resolution, METRO Group and Kaufhof, together with Wal-Mart, other user companies, and university labs engaged EPCglobal, an international nonprofit organization. In December 2004, EPCglobal approved the generation II (Gen II) standard. Gen II specified a UHF frequency range and thereby settled the open issue.

Following an internal debate over the switch to Gen II, in March 2005, METRO Group's Information Technology unit conducted lab trials in its Innovation Center in Neuss, Germany. Based on its own experiences, the downward compatibility of the standard, and presentations by RFID innovator Impinj Inc, METRO Group decided to adopt Gen II for its distribution centers (Wolfram 2006b).

Kaufhof followed METRO Group in the adoption of Gen II for RFID on unit level, even though the standard did not operate with the HF transponders used in the pilot.

4.3 Toward Kaufhof's RFID Adoption on Item Level

Driven by positive experience and increasing standardization, Kaufhof began to approach RFID at the item level. Transponder cost and readability again were crucial as Kaufhof proposed to tag and process about 70 million textile items per year.

The affordability threshold of transponder cost at €0.10 had not yet been achieved (Kanzok 2004). But the cost had decreased substantially since 2003, to about €0.15 in October 2006. Concluded Wilfried Kanzok (2006), "it took us about three years to improve the tag quality and to bring the tag cost down; it seems that we are not that far away from actual item level roll-out being economically feasible for fashion goods."

Transponder readability had also improved tremendously for two main reasons since the Kaufhof–Gerry Weber pilot: (1) European regulators allowed stronger energized UHF equipment in early 2005, thereby facilitating wider reading ranges; and (2) in June 2006, Impinj Inc. presented fashion-specific RFID systems capable of reliable near- and long-field reading independent of previous inhibitors. This development assured further utilization of existing equipment in distribution centers and stores.

While METRO Group engaged in overall RFID standardization across industries, Kaufhof focused on establishing fashion industry RFID standardization of data transfer and processes. Kaufhof considered such standards necessary for item-level RFID adoption. Such standards would allow monitoring 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 (AFF BAG). In its standardization efforts, the group also incorporated approaches by the Virtual Interindustry Commerce Solutions Association and American Apparel & Footwear Association.

At the end of 2006, the transponder costs were continuously decreasing, readability issues were almost settled, and industry RFID standardization was on the way (Speer 2006). Kaufhof decided to approach the adoption of item-level RFID using UHF (Wolfram 2006a).

4.4 Supply Chain RFID Diffusion

Approaching an RFID-enabled end-to-end supply chain, Kaufhof increasingly approached *diffusion to fashion manufacturers*. Between December 2004 and June 2005, it invited Gerry Weber and the fashion manufacturers Esprit and Triumph to participate in unit-level RFID adoption. Kaufhof and the manufacturers applied RFID to perform (1) the check-out of units from the manufacturer, (2) the check-in at Kaufhof's distribution centers, and (3) the so-called "cross-docking," where suppliers' shipments to distribution centers were directly—without any further storing—repackaged to orders and further distributed to recipients. To guarantee working interorganizational processes, Kaufhof kept barcodes in use as a backup.

Kaufhof originally anticipated that manufacturers would only reluctantly adopt RFID due to the associated costs and possible lack of know-how. To its surprise, several manufacturers rushed forward to adopt RFID, even before infrastructure standardization was approved. For a while, they even successfully continued with Gen II incompatible HF equipment. In contrast Kaufhof's initial RFID partners, Gerry Weber, Esprit, and Triumph, followed the EPCglobal path and switched to Gen II upon availability.

In order to foster RFID *diffusion to small fashion retailers*, Kaufhof wanted to be able to suggest a business case taking into account their often limited financial resources. It gratefully acknowledged technology conglomerates, telecommunication providers, and large software vendors, who developed out-of-the-box plug-and-play RFID systems with reduced complexity, especially geared toward the needs of smaller retailers (Wearden 2004).

By September 2006, Kaufhof and competing retailers as well as manufacturers of all sizes had adopted RFID in logistics. The established end-to-end RFID logistics infrastructure facilitated new applications along the supply chain.

5 DISCUSSION

The discussion follows the theoretical concepts and their associated factors of organizational technology adoption and diffusion as outlined in section 3. It investigates the role of external influences, perceived organizational benefits, and organizational characteristics for Kaufhof's RFID adoption and for the RFID diffusion in the fashion industry.

5.1 External Influences

Kaufhof conducted a rational decision-making process toward RFID adoption. As an RFID pioneer in fashion, it experienced no coercive pressure from other supply chain participants. However, as a METRO Group sales division, Kaufhof participated in the METRO Group RFID strategy. Therefore, Kaufhof's RFID adoption was not entirely independent.

Once Kaufhof had adopted RFID, it convinced additional supply chain partners to join. In contrast to Kaufhof, smaller or more hesitant companies experienced coercive power exercised by the large, powerful fashion retailers.

METRO Group and Kaufhof were innovators concerning the trial and adoption of RFID. Therefore, the adoption could not be specifically attributed to isomorphism in

retailing or in the fashion industry. However, the early ambitious implementation schedules issued by the world's largest retailers such as METRO Group and Wal-Mart combined with positive feedback from the capital markets suggested some isomorphic adoption tendencies for late movers in RFID.

Kaufhof's adoption was justified with information and expertise gathered from several differently organized external sources. Through its parent METRO Group, Kaufhof benefitted from the expertise of a number of technology vendors and technology consultants, who participated in the METRO Group Future Store Initiative (Loebbecke 2004). Kaufhof received the necessary information from technology vendors who envisioned a large market potential for RFID in the fashion industry and therefore were willing to cooperate. Finally, Kaufhof exploited its membership in industry organizations and associations and took advantage from their know-how concerning infrastructure and business processes.

5.2 Perceived Organizational Benefits

To adopt RFID, Kaufhof had to integrate hardware with software and to adapt inter-organizational business processes along the supply chain. It reduced necessary integration efforts by adopting RFID in stages. Learning from its own pilot, Kaufhof stretched adoption over time. It first adopted RFID on the unit level and then on item level, thus mitigating integration risks.

Kaufhof decided on the adoption of RFID at a time when the RFID-related standardization of infrastructure, frequency, numbering, and business processes were still rudimentary. Nevertheless, being aware of the necessity and importance of standards, Kaufhof opted for active participation in the standardization processes. Well known for its RFID pilot, it earned the role of an RFID opinion leader, which gave it a strong voice in the standardization process. Only after the approval of standards did Kaufhof pursue a full-fledge RFID implementation, thus reducing the risks of island solutions along the fashion supply chain.

RFID only added an innovative component to Kaufhof's existing supply chain management system. Therefore, the quality of service played only a subordinate role even though reading rates of 100 percent at fast speed and bulk reading were conditional to adoption. Backup solutions guaranteed the overall quality of service. For instance, in the transition phase, Kaufhof maintained barcodes as backup for RFID to assure high quality of service.

Due to the extended implementation period, Kaufhof could not assess the financial benefits prior to project finalization. However, based on the pilot and its business case, Kaufhof had positive expectations regarding the long-term financial benefits of its RFID endeavor.

5.3 Organizational Characteristics

Beyond bundling its IT competences in the METRO Group Information Technology unit, METRO Group also signaled IT commitment both internally to Kaufhof and its other sales divisions, and externally to technology partners and supply chain participants.

Internally, METRO Group signaled commitment by allocating resources. Reaching beyond company boundaries, METRO Group and Kaufhof participated in technology events and issued press releases and executive statements concerning RFID. METRO Group's and Kaufhof's commitment to IT raised the willingness by Kaufhof's partners to join them on the long and challenging RFID adoption path.

Similar to the institutional commitment, the executive managers of both METRO Group and Kaufhof exhibited personal commitment and support for the RFID project. They gave high priority to activities supporting RFID adoption and developing RFID diffusion strategies. For instance, METRO Group's Board Member Zygmund Mierdorf joined the board of GS1, an association that standardizes RFID business processes.

Kaufhof's size and buying power in fashion retailing supported its role as opinion leader and its coercive power along the fashion supply chain. Potential partners became eager to participate in the RFID initiatives of METRO Group and Kaufhof. Even hesitant manufacturers jumped on the RFID bandwagon in order to not lose their position as supplier to Kaufhof. Other manufacturers adopted RFID to increase their chance to newly enter Kaufhof's supply chain.

6 CONCLUSIONS AND FURTHER RESEARCH

This paper described the case of organizational RFID adoption by Kaufhof and of RFID diffusion in the fashion industry. It analyzed and discussed theoretical concepts and associated factors from the literature as they could play a role in the organizational adoption process.

The case of Kaufhof and the fashion industry only partly supported the literature on organizational technology adoption and diffusion.

With regard to external influences, the most powerful entity in the supply chain was not exposed to coercive pressure from other supply chain members, but, as a subsidiary, it experienced coercive pressure to adopt the strategy of the parent company. Due to the specific context of industry innovators, isomorphism appeared not to exist. However, the availability of technology and business process information seemed to drive adoption, especially in the case of early adoption where best practices did not yet exist.

Concerning perceived organizational benefits, a successive adoption process allowed circumventing prohibitively high integration efforts. Infrastructure and business process standards for fashion accelerated RFID adoption, while leaving enough differentiation potential to RFID applications. With barcode technology serving as backup, the quality of service provided with the RFID technology was sufficient throughout the adoption and diffusion phases. Early RFID adoption and the resulting opportunity to shape the industry's technology development path led to perceived financial benefits.

Referring to organizational characteristics, size implied bargaining power, which exerted pressure on upstream supply chain members to also adopt RFID. Internal and external commitment and top management support for the RFID project depicted convincing, trust-building signals to potential partners.

Overall, this paper illustrated and investigated RFID adoption and diffusion from the perspective of a powerful industry leader. Extending our qualitative work and accepting obvious limitations of factor models for analyzing complex stories, future research may

want to tackle the perspectives of small manufacturers or technology vendors. Also, it could analyze organizational RFID adoption issues in the context of closed systems where RFID adoption and operation are independent of other organizations. Finally, when sufficient data from the field is available, quantitative research could attempt to confirm that the identified factors influence RFID adoption across industry boundaries.

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