

2008

Cost-Benefit Sharing in Cross-Company RFID Applications: A Case Study Approach

Philipp Bensel

Technische Universitat Berlin, bensel@logistik.tu-berlin.de

Oliver Gunther

Humboldt-Universitat zu Berlin, guenther@wiwi.hu-berlin.de

Christoph Tribowski

Humboldt-Universitat zu Berlin, christoph.tribowski@wiwi.hu-berlin.de

Stefan Vogeler

Technische Universitat Berlin, vogeler@logistik.tu-berlin.de

Follow this and additional works at: <http://aisel.aisnet.org/icis2008>

Recommended Citation

Bensel, Philipp; Gunther, Oliver; Tribowski, Christoph; and Vogeler, Stefan, "Cost-Benefit Sharing in Cross-Company RFID Applications: A Case Study Approach" (2008). *ICIS 2008 Proceedings*. 129.
<http://aisel.aisnet.org/icis2008/129>

This material is brought to you by the International Conference on Information Systems (ICIS) at AIS Electronic Library (AISeL). It has been accepted for inclusion in ICIS 2008 Proceedings by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact elibrary@aisnet.org.

COST-BENEFIT SHARING IN CROSS-COMPANY RFID APPLICATIONS: A CASE STUDY APPROACH

*Partager les coûts et les bénéfices des applications RFID impliquant plusieurs
partenaires : une approche par études de cas*

Completed Research Paper

Philipp Bensel

Technische Universität Berlin
Straße des 17. Juni 135, 10623 Berlin
bensel@logistik.tu-berlin.de

Oliver Günther

Humboldt-Universität zu Berlin
Spandauer Str. 1, 10178 Berlin
guenther@wiwi.hu-berlin.de

Christoph Tribowski

Humboldt-Universität zu Berlin
Spandauer Str. 1, 10178 Berlin
christoph.tribowski@wiwi.hu-berlin.de

Stefan Vogeler

Technische Universität Berlin
Straße des 17. Juni 135, 10623 Berlin
vogeler@logistik.tu-berlin.de

Abstract

Although the highest potential for RFID in logistics is expected to be realized in cross-company applications, the status quo in the RFID project landscape is dominated by isolated solutions in specific fields. Reasons for this phenomenon are the high investment costs and the difficulty in assessing the benefits during the run-up phase. In network technologies such as RFID, the benefits depend on the spread of the technology in the network. A high discrepancy may result between the occurring costs and the resulting benefits for each of the network partners. This unequal distribution puts the success of the application at risk. To counter this trend, a balancing of costs and benefits should be considered. The research question of this paper is how these costs and benefits should be distributed among which participants. To develop a practical, relevant solution, we use an empirical research method based on an exploratory case study.

Keywords: RFID, Cost-Benefit Sharing, Supply Chain Management, Cooperation, Case Study

Résumé

Dans le cas d'applications RFID intégrant plusieurs partenaires, de gros écarts peuvent apparaître entre les coûts effectifs et les bénéfices dégagés pour chacun des acteurs. Ce papier traite donc de la question suivante: comment ces coûts et bénéfices devraient être répartis parmi les différents partenaires? Afin de développer une solution pertinente, nous utilisons une méthode de recherche empirique basée sur une étude de cas exploratoire.

Introduction

The spread of Radio Frequency Identification (RFID) technology has increased substantially in the last few years and professionals are even considering the possibility that it will replace barcode technology in the long run (ten Hompel 2006). Although the highest possibility of taking advantage of this spread is expected to be realized in cross-company applications, the status quo in the RFID project landscape is dominated by pilot projects and isolated solutions in specific fields.

One of the reasons for this phenomenon is the high investment and operational costs (Straube et al. 2005, pp. 54-55). In the course of using a collaborative RFID application, these costs should be reduced for the individual player by distributing them between a larger number of participants and the repeated use of the same tag across multiple supply chain steps. On the other hand, high RFID costs are no longer the crucial factor if the expected benefits exceed them.

However, in a multi-echelon supply chain, the players engage in such different functions that the potential benefits will not be distributed equally among all participants. While manufacturers and logistic service providers prefer to track the flow of cases or pallets, retailers typically gain the highest benefit by tracking individual items on the sales floor (Gaukler and Seifert 2007, p. 44). In summary, the reasons for these problems are based on the fact that the resulting expenses and benefits realized are by no means economically fairly distributed among the participants. The concept of fairness in this context does not assume an equal distribution of costs and benefits, but rather has to be interpreted subjectively: all participants need to feel that they are being treated fairly, because the success of a collaborative RFID application depends, to a great extent, on the acceptance of the participants.

To create this acceptance, the balancing of costs and benefits should be considered. The research question of this paper is *how* and to a lesser degree *which* of these costs and benefits should be distributed among which participants in the context of a cross-company RFID application. Giving answers to these questions is the mission of cost-benefit sharing – the focus of this work. To develop a practical, relevant solution, we use an empirical research method based on an exploratory case study. To ensure that the obtained knowledge is generally valid, we complement the identified characteristics in the case study with findings from literature.

Taken together, the contribution of our paper is fourfold:

- With cost-benefit sharing in cross-company RFID applications, we address an innovative topic which is on the current research agenda.
- Applying an empirical research method, our findings are closely related to practical problems and so suggested measures could be easily implemented.
- With the case study about cost-benefit sharing in an item tagging RFID application in the fashion industry, we present a real-world application which can be used as an example later on.
- We deduce strategies for the different phases for an RFID application project life cycle.

The paper is structured in the following way: first, we define what we understand as cross-company RFID applications and give an overview about the related costs and benefits. On this basis, the necessity for a redistribution of costs and benefits is explained. Subsequently, the research questions of this paper are framed based on related research and a general discussion of the aspects of cost-benefit sharing – including influencing factors and a cost-benefit analysis. This is followed by an in-depth presentation of an exploratory case study about cost-benefit sharing in the fashion industry. Finally, we answer the research questions by highlighting two different aspects of the design approach for the cost-benefit sharing presented in the case study: categories of compensation as well as temporal dependencies during the life cycle of a cross-company RFID application.

Costs and Benefits of Cross-Company RFID Applications

RFID technology is used for object identification and can be applied in numerous scenarios in almost all industries. According to the CE RFID initiative's RFID reference model (CE RFID 2007), there are eight application fields which can be differentiated: public services; sports, leisure and household; health care; smart cards with customer, membership and payment functionalities; access control and tracking & tracing of people and animals; product safety, quality and information; production, monitoring and maintenance; as well as logistical tracking & tracing.

For the purpose of this paper, an important restriction on these RFID applications is that objects tagged with RFID are handled across companies. The resulting application fields for RFID concern supply chain management. It is defined as the cross-company coordination and optimization of product, information and financial flows across the entire process from primary production through all processing steps to the end consumer (Arndt 2005, p. 46). This definition explicitly includes local applications at certain processing steps; and we also take them into consideration as long as RFID tagged products, logistical units, carriers, etc. – or through this tagging created data – are exchanged between at least two involved supply chain participants.

In this context, RFID applications are mostly separated into open and closed loop systems. In open loop systems the transponder remains on the product after it has been sold. In closed loop systems the transponder is either removed at the end of the supply chain, carried back and reused; or together with the tagged object, e.g. a carrier, introduced to the closed loop again. Hence, a cross-company use does not inherently imply an open system. Consequently, locally closed, collaboratively closed and globally open systems can be differentiated from each other in principal (Strassner 2005, p. 126). In the following, the locally closed systems are excluded, because in this kind of application a *sharing* of costs or benefits would not be relevant at all.

Cost Drivers of RFID Applications

An RFID system basically consists of transponders, readers and data processing information systems. The costs for readers as well as the costs for information system hardware and software are defined as *infrastructure costs*. The amount of expenses is highly dependent on the complexity of the RFID application. This complexity is driven by the integration of additional re-writeable memory (e.g. for use in production) or of one or more sensors (e.g. for monitoring the cold chain); and different forms of readers (e.g. mobile handhelds, identification gates or integrated into shelving units). Also software costs have to be considered. With these costs, the initial purchase prices for the software have to be taken into account as well as the costs associated with customizing, designing and implementing the interfaces to the existing information systems, or even modifying these legacy systems. Besides the integration costs for software and hardware (e.g. installation and configuration), it is essential to take training costs and costs for business process changes into consideration, because these costs often dominate the direct costs (Brynjolfsson and Hitt 1998, p. 55; Irani 2002, p. 22).

Only the one-time costs of an RFID application have been discussed so far. Additionally, the recurring *operating costs* are of great importance. Of these costs, transponders easily have the majority share in open loops. Further costs which fall into this category are costs for control, maintenance, repair and replacement of hardware, as well as yearly dues for unique manufacture IDs (from GS1) or shared services.

To create transparency in the cost structures of an RFID application, the total cost of ownership (TCO) analysis is an appropriate method to follow. The goal of a TCO analysis is to assess the indirect costs of an IT workspace as well as the usual direct costs. An important observation which should be assigned to RFID systems is the fact that costs for installation, integration, education, support, as well as administration and maintenance of the applications are often significantly higher than the one-time costs.

Besides the distinction based on how costs occur (one-time vs. operating), the distinction based on the activity level (fixed and variable costs) has to be taken in consideration. While infrastructure and integration costs compose the fixed costs of an RFID application, the transponder costs in open systems are variable depending on their relative base: here the tagged objects. Important influence factors for the quantity of transponders are integration depth and scope. The integration depth consists of the level of material flow (tagging of pallets, cases or items) and the objects' quantity on the corresponding level (classified in ABC goods by the following criteria: relevance, replacement effort, current value and shrinkage rate) (Strassner 2005, p. 123 et seq.). The integration scope describes the distinction between open and closed systems and their sub categories. While the transponders are the cost

determining factors in open systems with a large quantity of objects which need to be tagged (Strassner and Fleisch 2005, p. 47), the importance of their acquisition costs decline with multiple use. If the transponders are removed from the objects at the end of the chain, the expenses for recirculation and reuse, instead of acquisition costs, become dominant (Tellkamp and Quiede 2005, p. 156).

Potential Benefits of RFID in the Supply Chain

The impact of RFID implementation into the supply chain can be characterized in two different ways: on the one hand, the efficiency of existing processes can be improved; on the other hand, new processes, products or services are enabled because of the radical reorganisation (Leimeister et al. 2007, p. 48). This categorisation is used by various authors and is called *process automation vs. process innovation* (Melski 2006, p. 23 et seq.) or *existing vs. new games* (McFarlane and Sheffi 2003, p. 12 and 20), for example.

The advantages of RFID over barcode technology include the possibility to simultaneously identify several objects without contact, without line of sight and without human interaction. Furthermore, additional data can be stored on RFID transponders which can be rewritten many times. Not only different product classes, but also each individual item in a product class can be distinguished. RFID transponders are also better protected than barcodes against environmental influences. Because of this, the benefits of automatic identification can be realized in all processes where manual registration activities take place. Due to the substitution of manual contact, the following two effects are achieved: first, the procedure is accelerated because there is less human interaction; second, mistakes (e.g. due to faulty inputs) can be avoided. In an automated goods receipt and goods issue, for example, the manual count of items, the check for completeness, the matching with the delivery receipt and the accounting entry into the system can be omitted. In general, in all processes a 100% check instead of a sample check can be done without extra effort. Further processes which need manual registration activities are the placing and releasing from stock, picking and packing, as well as the cycle count.

The possible savings due to these automation effects (substitution of manual work and due to higher data quality less follow-up costs because of mistakes) are to a great extent dependent on the automation level of the considered processes. In a very large distribution centre equipped with modern barcode technology, for example, the automation potential is less than for uncoordinated container management processes (Strassner and Fleisch 2005, p. 48). Therefore, the automation level is an influencing factor on the potential benefits for each specific participant. On the other hand, the increased productivity due to higher automation does not have an immediate effect on economic advantages for firms. The increased productivity has to be translated into cost reductions first. In general, this succeeds either by an organic growth of the firm without hiring new employees or by the reduction of jobs.

The second important point is that the adoption of RFID can lead to a process redesign. The amount of actual product inventory in a supply chain can be determined faster and more accurately. With other technologies this is only possible with huge cost inputs. On the basis of this higher level of visibility (Dittmann 2006, p. 160), the adoption of new inventory and order policies becomes feasible. Furthermore, a warehouse could be chaotically structured according to efficiency criteria instead of purposes of clarity if the warehouse workers are supported by a pick by light application (Sheffi 2004, p. 12). In addition, by using data storage on objects, new services (e.g. processing of warranty, innovative accounting methods and proof of product authenticity) become possible (Strassner 2005, p. 137 et seq.).

The potential benefits realized by the introduction of RFID applications for process automation and innovation mentioned above, appear in different ways in each step of the supply chain; therefore, in numerous publications, the investigation of RFID benefits concerns production (see, e.g., Bapat and Tinnell 2004; Günther et al. 2008); transportation and warehousing (see, e.g., Alexander et al. 2002); the point of sale (see, e.g., Loebbecke 2004; Thiesse and Fleisch 2007) as well as cross-company supply chain processes (see, e.g., Gaukler and Seifert 2007).

RFID benefits in production can be realized by closed local applications, e.g. RFID in asset management for an improved capacity utilization of machines. This kind of RFID benefit is only relevant insofar that other applications – also at supply chain partners – are provided with more accurate, detailed and timely information. Basically, the tagging of products during production enables the implementation of other applications. RFID technology can be used in production management to monitor the progress of production by reading and writing the transponder data at selected production steps (Melski 2006, p. 41). Through RFID-based production monitoring, flexible production concepts can be realized when production steps are controlled, modified, and reconfigured. In the assembling process, RFID can be used to check that the correct components are used, e.g. by tagging raw materials with detailed

specifications and automatically triggering alarms at assembling operations if the usage of an incorrect part is imminent (Bapat and Tinnell 2004, p. 10). In the case that faulty products have to be recalled, the traceability of production runs or even individual products can be improved by the use of RFID tagging.

In transportation and warehousing, primary efficiency improvements through less labour, higher accuracy and higher performance is the next point which is often discussed. These can be realised in goods receipt, goods issue as well as picking and packing processes (Alexander et al. 2002, p. 15 et seq.). Future RFID applications enable the automatic self-control of logistic processes where the monitoring and controlling the destination of goods is done by the goods themselves or by intelligent systems which are connected with these goods.

One of the central problems in retailing which can be addressed by RFID is the on-shelf availability of goods. An automatic logging of the movement of goods in the store offers the possibility of redesigning the shelf replenishment process (Thiesse and Fleisch 2007, p. 1). An item-level tagging of products and the equipping of shelves; doors between storage and retail area; and the checkout with RFID readers create the needed transparency on the actual amount of inventory in the store. If the amount of products on a shelf falls below a critical level and the product is still available in the storeroom, shop clerks can be made aware of the imminent out of stock situation (Gaukler and Seifert 2007, p. 32). Additionally, with these smart shelves misplaced products can be easily recognized and the number of unsaleable products (e.g. due to expiry date) can be reduced. Further benefits in efficiency include accelerated check outs and integrated article surveillance. Apart from RFID applications for inventory control and efficiency improvements, the use of RFID in retail can contribute to a better shopping experience for the customer. In the clothing industry, an example of this improved experience is a smart changing room, where suggestions of combining the selected clothing with other articles and availability information of other sizes and colours are displayed. For fast moving consumer goods, the customer could get product specific information on the shop floor (front-end content integration), e.g. about the origin of the products (Loebbecke 2004).

While the above described benefits can be separately realized at each step of the supply chain, some benefits do not occur until the whole supply chain is considered. By using real-time information about inventory and the demands of each actor in the supply chain, the safety stocks and the bullwhip effect (the built up fluctuation of demand from retailers to suppliers) can be reduced. This assumes the willingness of the participating companies to share the needed information (e.g. about current production utilization, current inventories, and point-of-sale data). Due to more detailed localization information and organizational actions about the property transfer of goods in the supply chain, the loss of products, e.g. due to internal or external theft, could also be reduced. In addition to the direct amount saved because of writing-off these losses, the transparency of current inventories is improved and therefore the safety stock can be reduced further (Alexander et al. 2002, p. 18). Together with these, the tracking and tracing of products in a supply chain can be improved because of more detailed information about location, origin and product history; thus, better protection against counterfeiting, faster warranty services and more tightly focused.

Necessity for a Redistribution of Costs and Benefits

In cross-company RFID applications, costs should be reduced for individual companies by distributing the costs between a larger number of participants and by repeatedly using the same tag across multiple supply chain steps. Looking closer at the benefits shows that they have to be differentiated into individual benefits and overall benefits. Individual benefits describe the benefits which each individual company can gain. Usually, more participants are involved in the creation of one company's individual benefits. The overall benefits are the cumulative benefits of all participating companies in the system. These benefits can exceed the sum of the individual benefits in a non-cooperative situation, because of the synergetic effects in a collaborative one (Strassner 2005, p.122).

Because of this reason, the participation of each company might significantly affect the overall benefit of the system. Taking the implementation of RFID in the textile supply chain as an example, the greatest benefit will be realized at the retail level because of the early information about product availability at the item-level on the sales floor (Gaukler and Seifert 2007, p. 44). The overall benefit increases with the integration of further supply chain steps, because the flow of materials control becomes more effective with higher information accuracy and more timely information availability. For this scenario to work, products have to be tagged by the manufacturer, who only marginally benefit from the overall application. A discrepancy between where the costs incur and where the benefits are realised emerges.

The disadvantaged company lacks the motivation to participate in the cross-company RFID application and, therefore, the overall benefits are at risk (Tellkamp 2006, p. 143). Hence, a solution has to be found so that the

circumstances are reached where the application is economically reasonable for every partner. The goal of cost-benefit sharing is the *economically fair* distribution of resources between the supply chain participants. Although the term *fairness* is part of habitual language use, it is difficult to derive a concrete definition. Fairness always has to be comprehended subjectively. It has to be applied to the others, and they have to decide if the situation is just and appropriate in the circumstances. That does not require an equal distribution. A situation in which costs and benefits are distributed unequally can be *perceived* as fair as well. To extend the definition of the goal of cost-benefit sharing: it is the creation of a situation in which all participants perceive to be treated economically fair enough to actively take part in the network activities in the long-run.

The highest incentive to create this situation is up to the stakeholder with the greatest share of the overall benefit. This participant will be willing to carry the costs of others or share the benefits with others until his share of the overall benefits is equal to his individual benefits. Special attention has to be put on the power structures in the supply chain (Fisher et al. 2004), which have a great influence on the individual subjective perceptions.

Cost-Benefit Sharing

The following section gives an overview of existing literature about research on cost-benefit sharing. Based on the findings of this literature review and a subsequent general discussion of the aspects of a cost-benefit sharing – including influencing factors and the cost-benefit analysis – the research questions for this article will be framed.

Related Research

Research in the area of collaborative investments into network technologies in general and especially RFID is quite low. Although evidence in case studies show that a successful RFID introduction will imply some cost-sharing (Günther et al. 2008, p. 155; Tedjasaputra 2007) and even the public sector is calling for closer co-operation between participants along supply chains which will generate true win-win situations and generate economic effects through cost-sharing models (Bovenschulte et al. 2007, p. 41). They state that these cost-sharing models should be derived from pilot projects. Other studies show that alternative cost-sharing models (in contrast to the scenario where the suppliers pay the majority of the costs) could solve the issue of collaborative investments, but are currently not in use (Weber and Jensen 2007, p. 34).

Regardless of this lack of research, there are a few cost-benefit sharing concepts in the context of supply chain management; but they are either too focused for the purposes of cross-company RFID applications or very broad. Jain et al. (2006) developed an economic order quantity based model to quantify the benefit accrued due to supply chain coordination and described a benefit sharing mechanism which is based on the optimal order quantity of the supply chain system. One of their assumptions is that the supplier is willing to share its benefits with the retailers, not only to compensate for their loss, but also to share the profit accrued due to coordination. In the other focused research paper, Chalasani and Sounderbandian (2007) developed a model for sharing the costs of a virtual private network among the partners of a B2B supply chain information system. Both fixed and variable costs were taken into consideration. In this technical-related calculation, variable costs were charged for the number of bytes transmitted through the network over an accounting period.

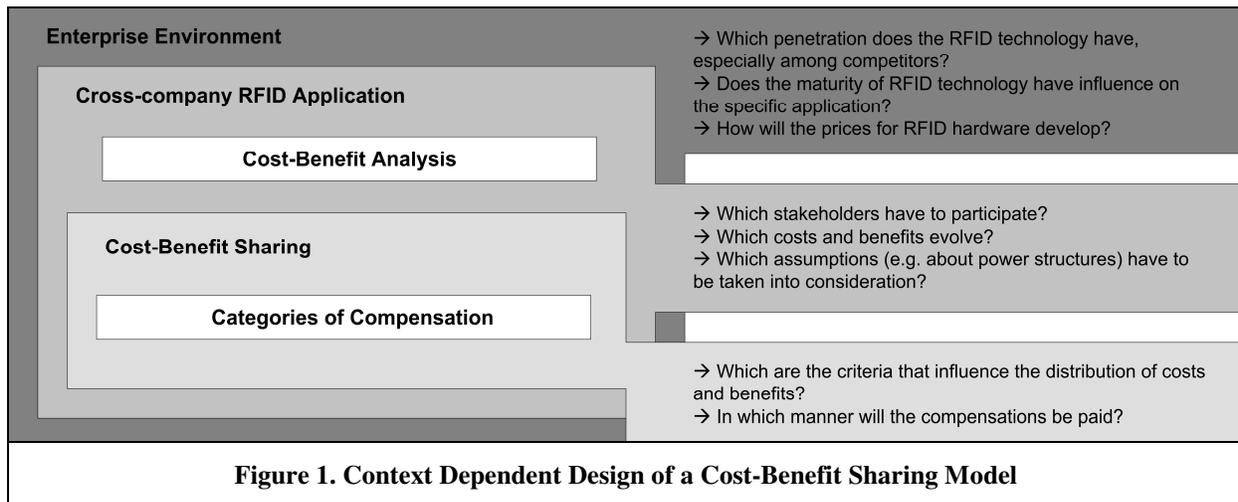
On the other side of the spectrum, general approaches for cost and/or benefit sharing in supply chain management have been developed. Cachon (2003) reviewed and extended the supply chain literature on the management of incentive conflicts with contracts. The coordination of companies becomes necessary if the supply chain participants are primarily concerned with optimizing their own goals, which are often not aligned with those of the whole supply chain. A number of different contract types, which all establish a transfer payment scheme, were identified. While Cachon (2003) used quantitative models to calculate the needed optimal parameters, Riha and Weidt (2004) stated that such models are practically irrelevant. The main reason is that the model assumptions are too restrictive and, thus, the practical application of the results of this research is limited. For this reason, they developed a framework for rules of cooperation in networks and proposed a measurement of supply management key figures, using a Balanced Scorecard (Kaplan and Norton 1992). Because only their initial research was presented, Riha and Weidt (2004) did not explain how a model for cost-benefit sharing should look like. Along the same lines, Wildemann (2005) stated that the benefits of supply chain improvements have to be identified and quantified first; therefore, he suggested a concept to measure tangible as well as intangible benefits in the form of key performance indicators. In the end, the allocation of costs between the supply chain participants should be based on this quantified value of

supply chain benefit. As in Riha and Weidt's (2004) work, the substance in the model for cost-benefit sharing was missing. Subsequently, Hirthhammer and Riha (2005) presented a comprehensive approach for a cost-benefit sharing framework which consists of two layers. The structural layer provides an institutional frame for the network, consisting of a board, information broker, controller, mediator and the companies themselves. The cost-benefit sharing process is described on the operational layer and contains: analyses of the network; the cost-benefit sharing itself; an implementation phase; and a controlling process. Although a very detailed cost-benefit sharing framework is presented in Hirthhammer and Riha (2005), two disadvantages make it unusable for our purpose. First, in the most important cost-benefit sharing process, the components are only named and not explained further. Second, in our opinion the overhead produced by the different institutions and support processes are an obstacle for practical applicability.

Finally, there exists one piece of research which has applied a cost-benefit sharing model to the introduction of cross-company RFID applications. Gaukler et al. (2007) addressed the question of how the RFID tag costs should be shared among the supply chain partners if the costs and benefits of a collaborative technology are distributed in an asymmetric fashion. To answer this question, an analytical model of item-level RFID in the retail supply chain was developed. It was shown that sharing the tag costs is not an issue when the manufacturer is the more powerful partner. However, when the retailer is more powerful, there is a need for sharing tag costs. The optimal tag cost allocation was calculated depending on a manufacturer's participation constraint. Although the paper addresses a similar research question in relation to our paper, the approach is completely different. To apply quantitative modelling as a research method, restrictive assumptions have to be made to simplify real-world complexity. The effect of this is its non-applicability in practice. However, to our knowledge, no empirical research exists which puts a cost-benefit sharing into the context of cross-company RFID applications. Thus, our paper breaks new ground by developing a practical, relevant model for cost-benefit sharing in cross-company RFID applications.

Aspects of Cost-Benefit Sharing

Supply chain networks are, as mentioned above, highly complex systems with a number of different interacting participants. Hence, the configuration of an RFID application which is embedded in such a system and, therefore, the possible distribution of costs and benefits are influenced by a variety of factors. Sample questions for both external influencing factors from the enterprise environment and intra-enterprise characteristics are depicted in Figure 1.



At the end of the model, to allocate costs and benefits of a cross-company RFID application to the participants, it is important to collect the needed information to describe the configuration of the application as well as to understand the company-specific and cross-company influencing factors. For this reason, the influencing factors of cross-company RFID applications are first described. Subsequently, a cost-benefit analysis is specified. If the cost-benefit analysis has been applied in practice to the different individual situations and its results show that RFID technology is beneficial for the supply chain, then a fair cost-benefit sharing strategy should be applied with the final goal of increasing the chances of a successful introduction of a cross-company RFID application.

Influencing Factors on Cross-Company RFID Applications

The configuration of the supply chain being considered and the position of the participating companies in it are one of the most important factors which influence the realization of a cross-company RFID application. The reason for this lies in the fact that the distribution of costs and benefits is highly dependent on the tasks of each company. While the costs for RFID infrastructure and system integration accrue at every step in the supply chain, the participants have to invest in the RFID tags only once. The heterogeneity of potential benefits has an influence on the distribution of the benefits themselves, and can also lead to different expectations for the technology. While manufacturers and logistics service providers prefer to tag pallets or cases as a rule, retailers typically gain the greatest benefit from product tracking at the item-level on the sales floor (Gaukler and Seifert 2007, p. 44). The tagging level is, therefore, one of the significant influences, and it also depends on the product type. For pharmaceutical products or fashion goods, an item-level tagging will be more likely to be implemented in the next few years than for fast moving consumer goods. Subsequently, in some industries – in particular logistics, pharmaceutical and information technology – RFID is rated as more relevant (Knebel et al. 2007, p. 99).

Apart from these criteria, certain network characteristics have an influence on the introduction of RFID. Power relationships between the companies in the fast moving consumer goods supply chain, for example, are affected by brand effects on the part of manufactures and the high market share of a few big retailers who could threaten to remove certain products from their inventory. If the power structures are highly asymmetric, requirements can be placed and enforced without considering business partners (Gaukler and Seifert 2007, pp. 43-44). Furthermore, the length of the partnership will influence the introduction of a cross-company RFID application. The tendency is that long-term relationships which are contractually fixed result in a higher security of investments and facilitate the participation in collaborative RFID projects.

The boundary between supply chain specific factors and company characteristics is not always clear-cut. Following an up to date study (Knebel et al. 2007), representatives of larger companies attach a higher importance to the topic of RFID. Closely related to this is that the current technological resources of a company (Gross and Thiesse 2005) (e.g. application systems and identification technologies) either support the immediate introduction of RFID or cause additional costs and time for its implementation; as well, the internal availability of technical know-how in terms of operational experiences for the introduction of a new technology has to be considered. This expertise in investing in and implementing new information technologies forms a self-amplified effect; this is because investments in IT are closely related to the developments of the organizations structure, employee competences and processes and, therefore, the expertise can be seen as a business value which pays off in the long run itself (Brynjolfsson and Hitt 1998, p. 54 et seq.). Compared with this, a high level of automation of technical processes can negatively influence the value of possible benefits.

Table 1. Overview of Influencing Factors on Cross-Company RFID Applications		
External Factors	Supply Chain Specific Factors	Company Specific Factors
- price trend of RFID hardware	- potential costs and benefits	- potential costs and benefits
- technological maturity of RFID	- structure of the supply chain	- position in the supply chain
- standards in the sphere of RFID	- goals of the supply chain	- size of the company
- spread of RFID technology	- product type	- technical know-how
- measurement of benefits	- industry	- resources and organization
	- tagging level	- level of process automation
	- closed vs. open systems	
	- power structures	
	- length of relationships	

Apart from the internal factors described above, the decision to introduce RFID also depends on external ones (Strassner 2005, p. 127 et seq.). In recent years, the costs for RFID have dropped significantly. Nonetheless, compared to barcode technology, for instance, the costs for RFID are still so high that the price trend can be seen as an essential element. At present, RFID technology is experiencing fast technological progress, so that performance characteristics are increasing and existing physical limitations are being overcome. Ongoing product innovations might complicate the decision for a specific solution.

Closely related is the continuous standardization in the sphere of RFID, which in turn facilitates the integration of cross-company processes and application systems. Currently, with quite little spread of RFID technology, companies have the chances, from a strategic point of view, to position themselves as early adopters in the marketplace.

The last external factor identified in this paper is the difficulty of measuring the benefits. While efficiency benefits through automation can be quantified quite precisely, the effects of improved data quality and transparency or the strategic benefits just mentioned can not be measured easily.

Cost-Benefit Analysis

The basic requirement to *share* costs and benefits is their assessment. Before the introduction of the application, the costs and benefits can be estimated based on previous experiences or calculated under uncertainty. Calculation methods offer support for this task; however, a current study (Gille and Strüker 2008) shows that only fifty percent of the companies surveyed which plan to implement or currently use an RFID application apply at least one calculation method. Process key figures and scoring mechanism are used the most, but both methods are not suitable to make financial decisions. The total cost of ownership (TCO) analysis at least encompasses the investments in RFID technology. Additionally, activity based costing includes benefits through process automation. The net present value method offers a comprehensive financial evaluation of costs and benefits if the payments within an investment period can be predicted well.

Calculation methods are partly provided as tools created with expert knowledge. One example is the MS-EXCEL®-based RFID calculator from GS1 Germany and IBM (GS1 Germany 2005), which allows for the mapping of whole supply chains and offers a cost-benefit calculation for each individual company. For the measurement of benefits, the RFID calculator concentrates on efficiency improvements which can be gained through RFID. A second example is the Auto-ID calculator (Tellkamp 2003), developed by the Auto-ID Centre. This web-based tool, which stresses logistics applications, offers the possibility to get a rough financial overview about the use of RFID. A more detailed alternative for calculation is offered by the – also MS-EXCEL®-based – RFID/EPC Benefits Calculator, which was jointly developed by Stanford Global Supply Chain Management Forum and the Massachusetts Institute of Technology with financial support from EPCglobal (Lee et al. 2005). This tool especially addresses retailers and quantifies diverse kinds of benefits and costs.

Although the assessment of costs and benefits is of great importance for the overall topic, we will not focus on the different methods which have to be individually applied in each situation.

Cost-Benefit Sharing: Research Questions

The past sections have given answers to the questions: who is involved in an RFID application; which costs and benefits could be generated; and what influences the amount paid for compensation. The forth aspect of the cost-benefit sharing which is the focus of this article describes how the compensation can be realized. Since the literature review has shown there is a lack of research on this topic, the following research questions have been framed:

- *How should the costs and benefits of a cross-company RFID application be distributed among which participants?*
- *Which compensation measures are possible and how can these measures be structured?*
- *Which compensation measures are suitable for the different stages of the RFID implementation?*

In the following sections these questions will be answered based on the findings of a case study conducted within the fashion industry.

Case Study Gerry Weber

The following section presents a case study conducted within the fashion industry. The analyzed company – Gerry Weber International AG – is one of the leading users of item-level RFID in Germany.

Research Methodology

The case study method is popular in information system research as it provides an extensive insight into a company's activities and experience. Since the cross-company usage of RFID is a relatively new research field, the case study methodology is suitable for an integrated and extensive analysis of this problem. Case study research can be used for exploratory, descriptive and explanatory purposes (Yin 2003, p. 3). In contrast to quantitative research approaches, case studies aim to analyze single or multiple cases in regards to several dimensions of relevance (Boos 1993, p. 34).

The analysis of the case study provided in this article aims at disclosing elements and strategies of cost-benefit sharing in cross-company RFID applications. Based on the findings from the analysis, an approach to cost-benefit sharing will be developed which includes a categorization of different compensation alternatives.

For the selection of the case study several dimensions, including the complexity of the application, the number of companies involved and the state of RFID usage, had to be considered. In addition, accessibility to the relevant data played a critical role (Crowston 1991, p. 84).

With regard to the case chosen, different data sources were accessible when building the case study. On one hand, several publications of practitioners and scientists who dealt with Gerry Weber's initial RFID pilot are available (Loebbecke et al. 2006; Tellkamp and Quiede 2005; Tröger 2008). On the other hand, the authors had the opportunity to conduct personal interviews with leading participants of the initial RFID pilot as well as of the current RFID project.

Company Profile

Founded in 1973, Gerry Weber International AG is a German fashion and lifestyle company with global operations. Initially starting as a brand name manufacturer of women's wear, the company has grown into a corporate fashion group with various licensed products and a network of retail stores both franchise and company owned. The brand portfolio includes GERRY WEBER, TAIFUN-Collection and SAMOON-Collection and is sold at a growing number of stores, currently exceeding 240 worldwide.

With 2,160 employees, Gerry Weber International AG realized a turnover of over 507 million Euros and an EBITDA margin of 12.2 percent in the fiscal year 2006/2007, well above industry average. This success was based on a fundamental optimization process that included the outsourcing of logistics operations as a main driver (Gerry Weber 2008, p. 3 et seq.; Gerry Weber 2007, p. 1 et seq.).

While operations are outsourced, supply chain management – in particular supply chain design issues, the selection of service providers and planning activities – are regarded as core competence of the group's supply chain management team. Supply chain management at Gerry Weber aims at guaranteeing cost efficiency as well as shortening time spans between design/production and availability at the point of sale. Due to the business model of Gerry Weber, supply chain processes are relatively complex. Their three different distribution channels (wholesale, retail and online shopping) require specialized supply chain processes. New designs are delivered to stores every two weeks.

Gerry Weber operates a global sourcing system and relies on both full package service suppliers as well as cut-make-trim suppliers. 63 percent of the suppliers are located in the Far East, another 23 percent in Turkey and the rest in Eastern Europe. Their supplier base is constantly changing as a consequence of the ongoing search for more competitive alternatives. As mentioned above, logistics operations – including the aggregation of deliveries from different suppliers, transportation, quantity and quality control, preparation for sales, commissioning and delivery to the stores – are outsourced to logistics service providers (Gerry Weber 2008, p. 24 et seq.).

Setting of the RFID project

Gerry Weber constantly works to improve the efficiency and quality of its logistics. Among many other measures, Gerry Weber was among the first companies to explore the use of RFID in the textile supply chain. The group conducted a pilot project in 2003 in close cooperation with Kaufhof Warenhaus AG (a 100 percent owned subsidiary of the METRO Group) and involving several other partners, such as logistics and IT service providers and research institutions. 13.56 MHz tags were used to identify items and logistic units. Tags were applied at a distribution

centre operated by the logistics service provider. RFID was then used to track all tagged objects on their way to two dedicated Kaufhof department stores via a Kaufhof distribution centre. All sites involved, including the stores, were equipped with mobile or stationary RFID readers. The main objective of the pilot was to assess the benefits of RFID for the fashion supply chain and to get a detailed view of costs occurring and technological limits. The pilot was successfully completed and has proven that the technology is suitable for the fashion supply chain and a positive business case is possible. Most of the problems identified during the pilot were linked to the technology – e.g. insufficient read rates for bulk reads – or its costs (Tellkamp and Quiede 2005, p. 143; Loebbecke et al. 2006).

Based on the positive experiences from their pilot, Gerry Weber International AG has decided to start implementing RFID to identify and secure merchandise along the supply chain. The main objective in implementing an RFID system is the improvement of information quality concerning supply chain processes. Since Gerry Weber constantly tries to reduce the time span between production and sales, the importance of information visibility, to guarantee the availability of merchandise in the store, increases. In addition to benefits due to improved information quality – such as higher visibility, fewer out of stocks and accurate inventory data – Gerry Weber also plans to profit from the automation effects of the technology along the supply chain or in the stores, especially the reduced time for counting and identifying items. Additionally, using the technology Gerry Weber will be well prepared for potential RFID mandates by its wholesale customers and positions itself as one of the first movers which has introduced an operational cross-company RFID solution.

The fashion industry as a whole is seen as one of the leading industries regarding the cross-company use of RFID. Many companies have successfully completed pilot projects and are now starting to implement the technology (see e.g. Berger 2006, O'Connor 2006, O'Connor 2007, O'Connor 2008, Swedberg 2006, Swedberg 2007). Gerry Weber's approach differs in scope from that of many competitors as it encompasses the whole supply chain. Thus, supply chain partners – especially logistics service providers which operate distribution centres in Europe and consolidation facilities in sourcing countries – are involved in this cross-company project. With respect to power structures, Gerry Weber can be characterized as the most powerful company among the partners within the supply chain under consideration.

Gerry Weber has chosen IBM to coordinate the development and rollout activities of its RFID project as well as to operate the RFID solution once established. OATSystems is part of the implementation team and is in charge of the middleware solution. Checkpoint Systems provides tags as well as stationary and Intermec handheld reader systems.

Reusable tags which combine UHF EPC gen 2 transponder with EAS (Electronic Article Surveillance) functionality will be attached by the suppliers and used to track the merchandise into the stores where the tag will be removed at the check-out. Following the process requirements, different kinds of read points will be installed. In order to reduce complexity, the scope of the project is limited to the portion of merchandise that is sold via Gerry Weber's own retail stores and the implementation is segmented into three stages.

Implementation Strategy

During the first stage, the RFID solution is developed, tested and piloted at a limited number of sites. RFID infrastructure will only be installed at selected distribution centres in Europe and two retail stores. Starting with stage two, additional stores and all distribution centres will be involved. During the final stage, the infrastructure will be enlarged to cover even more stores and also be installed at the consolidation facilities in Asia and Turkey and at the sites of main suppliers (Tröger 2008). The progress of the project will be re-evaluated in terms of target achievement regarding costs and benefits after each stage.

Costs and Benefits

Implementing the RFID solution is associated with considerable costs at each stage. These include costs for developing, testing and installing the RFID solution; investment in hardware; recurring expenses for tags and tag returns; the operation and maintenance of the RFID infrastructure; and service charges for the RFID platform.

During the cost-benefit analysis, savings and increased revenues have been identified that will exceed those costs, from the supply chain point of view, once stage three has been successfully concluded. Benefits encompass, among others savings generated by automated scanning and handling processes, increased information quality which leads to higher flexibility and enhanced delivery quality. In addition, a change in the current EAS tagging process –

combining RFID and EAS and outsourcing the tagging to the suppliers – counters most of the tag-related RFID costs.

Need for Cost-Benefit Sharing

While implementing RFID is profitable for the whole supply chain, this is not necessarily the case for the logistics service providers. On one hand, a considerable share of the RFID installation can be allocated to their facilities. On the other hand, most of the logistics service providers lack the understanding of how to generate benefits for their operations from the technology. In order to win their support for the project, Gerry Weber has developed a cost-benefit sharing scheme.

Table 2. Gerry Weber's Cost-Benefit Sharing Approach (Following Tröger 2008)			
Stage	One: pilot	Two: run-up	Three: operations
Costs (paid for by Gerry Weber)	<ul style="list-style-type: none"> - development - testing - piloting 	<ul style="list-style-type: none"> - roll-out services - infrastructure: investment - infrastructure: service/maintenance - operations: RFID platform - operations: tag cycle 	<ul style="list-style-type: none"> - operations: RFID platform (proportionally) - operations: tag cycle
Costs (paid for by partners)	<ul style="list-style-type: none"> - none 	<ul style="list-style-type: none"> - none 	<ul style="list-style-type: none"> - operations: RFID platform (proportionally) - infrastructure: service/maintenance - tagging/initialization of tags
Benefits (to Gerry Weber)	<ul style="list-style-type: none"> - none 	<ul style="list-style-type: none"> - lessons learned 	<ul style="list-style-type: none"> - flexibility/event driven supply chain management - visibility - enhanced store processes (e.g. inventory, fewer out of stocks) - savings through combining EAS and RFID
Benefits (to partners)	<ul style="list-style-type: none"> - none 	<ul style="list-style-type: none"> - evaluation of benefits of the technology for own operations - evaluation of technology-related services 	<ul style="list-style-type: none"> - reduced costs for counting and handling merchandise - visibility - revenues through RFID-related services

Gerry Weber’s Approach to Cost-Benefit Sharing

According to the cost-benefit sharing scheme depicted in Table 2, Gerry Weber will bear all costs occurring during stage one and two. This does not only include hard- and software-related costs but also training measures. To enable the logistics service providers to take part in those stages, their basic RFID equipment will also be covered by Gerry Weber which allows them to evaluate the use of the technology for their operations. Once stage three is operational, the service providers are expected to co-finance a share of the RFID solutions’ operating costs. They should be able to derive additional benefits from the technology themselves at that time and also partially profit from the enhanced supply chain visibility that Gerry Weber is willing to share. Service providers will be remunerated for additional time and effort resulting from the use of RFID – for example tagging of garments if not done properly by suppliers (Tröger 2008) –, at least in the first two project stages.

Case Analysis

In the following section we answer the research questions by highlighting different aspects of the design approach for a cost-benefit sharing presented in the case of Gerry Weber.

Categories of Compensation

In the case study, several compensation measures were mentioned – including financial compensation for related costs, cooperative usage of hard- and software, provision of training courses as well as intangible values, such as the status as a preferred partner. To structure these compensations, a classification of economic goods will be used. According to this classification, economic goods can be divided into nominal – or monetary – goods and real assets, which can be tangible or intangible. Intangible assets are services, work force, information and rights (Meffert and Bruhn 2000, p. 32). According to the classification, compensations in the field of RFID fall into five categories: monetary, tangible and intangible compensations as well as combinations of these and no compensation at all.

Financial payments fall into the category of monetary compensation. On the one hand, these are financial compensations for expenses related to the RFID application – including the financing of RFID modules and IT systems, partial payments for operational expenses and the payment of a financial premium for additional services. On the other hand, revenues generated can be shared among the partners in form of single or continuous payments.

In the case of Gerry Weber, several of these measures for the cost compensations mentioned above were applied; however, a benefit sharing was not implemented. Gerry Weber is paying the operational expenses and is willing to pay a premium for RFID-related services (e.g. tagging of goods, association of transponder and product information); at least in the first two project stages. Since the company provides their suppliers and service providers with the required hardware and does not reimburse them for their expenses, no monetary but a tangible compensation is made.

Besides being provided with hardware, the collective or exclusive use of software by the partners is counted in the tangible compensation category. Both software and hardware can be made available for permanent or temporary use. In the case of temporary use, the assets can be claimed back or sold to the partner after the utilization period expires, e.g. after the technology tests. In general, all components of an RFID system – transponder, reading devices, middleware and application software – can be considered as assets and hence be part of a tangible compensation. Since the provision of assets requires a certain degree of stability in the buyer-supplier-relationship, this measure is not suitable for volatile procurement markets.

To avoid this problem in the early stage of the RFID rollout, only a few of Gerry Weber's established suppliers and service providers with long running contracts will be integrated.

The third category, intangible compensation, subsumes all the measures which include neither a financial payment nor a provision of assets. According to the classification of economic goods, intangibles can be distinguished into four subcategories: services, work force, information and rights (Meffert and Bruhn 2000, p. 32). In the case study, it is shown that Gerry Weber assists its service providers in site assessment and technology selection by providing its own staff and hiring consultants. Furthermore, the gathered information will be accessible not only to Gerry Weber, but also to its partners. Beside these, the assistance during the run-up phase and training are further potential measures where Gerry Weber can help its partners.

The fourth category contains possible combinations of the measures mentioned above. An example for a reasonable combination is the provision of RFID hardware combined with related training or assistance during run-up. For the sake of completeness, a fifth category – the exclusion of any compensation – is introduced. In case of asymmetric power structures and redundant partners, there might be a decision not to share costs and benefits. Examples for this option are so called RFID mandates which force suppliers to adopt the technology.

Table 3 summarizes the findings of this section by showing the structured categories and the RFID-related examples.

Table 3. Categories of Compensation Measures	
Category	Subcategory
1. Monetary compensation	<ul style="list-style-type: none"> - cost sharing: subsidy, full compensation - benefit sharing: payment
2. Tangible compensation	<ul style="list-style-type: none"> - provision of hardware (tags, readers, infrastructure) - provision of software - etc.
3. Intangible compensation	<ul style="list-style-type: none"> - information sharing - work force - training courses - prestige - knowledge transfer - better contract terms - etc.
4. Combination of the measures	<ul style="list-style-type: none"> - combination of categories 1-3
5. No compensation	<ul style="list-style-type: none"> - no interest - power constellation - difficulties in measuring and allocation - etc.

Temporal Dependencies

The RFID rollout described in the case study follows a realization plan which has multiple stages. The aim of this kind of multi-stage plan is to reduce the substantial risks (Kopalchick and Monk 2005) associated with the implementation of any innovative technology. The implementation of RFID is a complex process that depends on several parameters such as the number of participants involved, the type of application planned and the organizational and technological readiness of the supply chain under consideration. It is thus impossible to suggest a universally valid number of stages for the implementation of RFID; but it can be observed that the configuration of cost-benefit sharing is a function of the degree of implementation a supply chain has reached. This is especially true for the allocation of costs and benefits as the knowledge and ability to assess both evolves while implementation is proceeding. In order to avoid over-complication, we decided to analyze the impact of the degree of implementation on cost-benefit sharing based on the three stage implementation scheme from Gerry Weber.

The first phase is the pilot in which the possibilities and boundaries of the technology are tested within the operating process. Moreover, the technical feasibility and the expected economic benefits of the planned use cases are verified. At the beginning of the run-up, the technology is implemented in selected sites and tested with a limited number of tagged items in order to check if the single components of the technology work well together and the expected benefits can be realized. The scope of the last and final stage of the implementation plan is to lead the system into a stable, productive operation.

In the Gerry Weber case, all expenses resulting from the pilot are paid by Gerry Weber. Additionally, Gerry Weber supported its partners in applying the technology. These measures were chosen to guarantee the participation of the key partners. In general, all the measures of compensation were suitable for the pilot phase. Because of the difficulties in estimating the potential benefits, a combination of tangible and intangible compensation measures is likely to be preferred to a financial payment.

After the realization of a pilot project, a decision has to be made whether the RFID project should be taken to the next stage or terminated. The decision is based on an ex-post assessment of the costs and benefits of the pilot and an updated cost-benefit forecast for the rollout. Due to the higher information value of this analysis, the uncertainty can be reduced. Moreover, essential investments in hardware and software are already made during the pilot phase. The

second benefit resulting from the pilot phase is the experience gained, which can be used to identify additional fields of application. In the case of the service providers, the activities can be used to identify potential uses in their own operations and as references to acquire new customers.

In the case of Gerry Weber, it is expected that the service providers will expand their own RFID activities and become financially involved during the RFID run-up by investing in additional RFID equipment. That is why tangible compensation measures will not be applied in the run-up phase. More likely intangible measures, such as knowledge transfer, training courses and exclusive contract terms will be offered to the partners. Furthermore, Gerry Weber will pay its service providers and producers extra money for RFID-related services, such as tagging and information provision.

While pilot and run-up stages normally only last from some weeks up to a few months, the RFID system in productive operation will usually be used for several years. There is a high probability that contracts with suppliers and logistics service providers will to be renewed at some point after the system has gone operational. At that point, compensations will also have to be renegotiated. By then, all partners have gained a sufficient level of understanding of the costs and benefits associated with the use of the technology. Compensation measures can thus be agreed upon based on the actual costs and benefits identified for each supply chain partner.

Theoretically, all types of compensation measures are applicable during the lifespan of an RFID application. Monetary compensation for additional efforts related to RFID is no longer paid as a supplement, but is an inherent part of the renewed supply or service agreement. As with any other contract renewal, suppliers might be faced with demands for cost reduction by their customers. Suppliers should thus be able to derive maximum benefit from the technology for their own operations to reduce dependency on compensation payments. Experience from the presented and other cases suggests that initiators of the RFID application will reduce tangible compensation measures once the system is operational. That is to say, extensions and maintenance of the RFID infrastructure have to be covered by each supply chain partner.

Conclusions and Outlook

The benefit generated by a network technology, such as RFID, is related to the diffusion of the technology among the participating partners. Often, the overall success of applications depends on the participation of a single player – e.g. the supplier in the textile supply chain. For an economically reasonable decision, the benefits of each player have to be higher than the costs of the technology deployment. Since the distribution of costs and benefits usually is not economically equal, the necessity of redistribution arises.

Within this paper, the costs and benefits of an RFID deployment were discussed; moreover, the elements of a cost-benefit sharing were presented. For the design of a cost-benefit sharing model influencing factors, such as the power structure or the progress of the technology, have to be kept in mind. To assess costs and benefits, different analysis tools can be used. Since the benefits of an RFID deployment are difficult to forecast, the reliability of ex-ante calculation is low; hence, a cost-benefit analysis has to be conducted several times during the rollout. The rollout should be structured into several phases – the pilot, the run-up and transition to productive operation. The design of the cost-benefit sharing changes from phase to phase.

For compensation, different measures can be applied: financial payments, tangible and intangible measures. The tangible measures include the provision of hardware and software. Potential intangible measures are, for example, the assistance in site assessment and technology selection or the sharing of information. The analysis of the case study has shown that, in the pilot phase, a combination of tangible and intangible measures are preferred. In the run-up phase each partner has to contribute financially. In the productive operation, partners get paid for RFID-related services and profit from intangible compensation measures.

These research findings are based on the analysis of a single case study and the experience of the authors gained from several other RFID projects. In the next step, the results will be validated with a quantitative analysis.

References

- Alexander, K., Gilliam, T., Gramling, K., Kindy, M., Moogimane, D., Schultz, M., Woods, M., “Focus on the Supply Chain: Applying Auto-ID within the Distribution Center”, White Paper, 2002, http://www.fmi.org/technology/fmi_pwc_dist.pdf, last access on 2008-02-26.

- Arndt, H. *Supply Chain Management – Optimierung logistischer Prozesse*, 2nd ed., Gabler, Wiesbaden, Germany, 2005.
- Bapat, V. and Tinnell, K. “RFID in Manufacturing”, Whitepaper, Rockwell Automation, 2004.
- Berger, D. “RFID-Roll-Out beim BekleidungsHersteller gardeur AG”, in *ident*, (4), 2006, pp. 20-21.
- Boos, M. “Die Fallstudienmethodik”, in *Empirische Personalforschung*, Becker, F. G. and Martin, A. (Ed.), Rainer Hampp Verlag, München, Germany, 1993.
- Bovenschulte, M., Gabriel, P., Gaßner, K., and Seidel, U. “RFID: Opportunities for Germany”, Federal Ministry of Economics und Technology Germany, Report, 2007.
- Brynjolfsson, E. and Hitt, L. M. “Beyond the productivity paradox,” in *Communications of the ACM* (41:8), 1998, pp. 49-55.
- Chalasani, S. and Sounderpandian, J. “Performance Benchmarks and Cost Sharing Models for B2B Supply Chain Information Systems” in *Benchmarking: An International Journal*, (11:5), 2004, pp. 447-464.
- Cachon, G., “Supply Chain Coordination with Contracts”, in *Handbooks in operations research and management science*, Graves, S., and de Kok, T. (Ed.), North-Holland, Netherlands, 2003.
- CE RFID “RFID Reference Model”, Coordinating European Efforts for Promoting the European RFID Value Chain, <http://www.rfid-in-action.eu/public/>, 2007, last access on 2008-02-26.
- Crowston, K. *Towards a Coordination Cookbook: Recipes for Multi-Agent Action*, Dissertation, Alfred P. Sloan School of Management, Massachusetts Institute of Technology, Harvard University, 1991.
- Dittmann, L. *Der angemessene Grad an Visibilität in Logistik-Netzwerken. Die Auswirkungen von RFID*, Dissertation, Universität St. Gallen, Switzerland, 2006.
- Fisher, R., Ury, W. L., and Patton, B. *Das Harvard-Konzept: Der Klassiker der Verhandlungstechnik*, 22nd ed., Campus, Frankfurt/Main, Germany, 2004.
- Gaukler, G. M., Seifert, R. W., and Hausman, W. H. “Item-level RFID in the Retail Supply Chain,” in *Production and Operations Management (POM)*, (16:1), 2007.
- Gaukler, G. M. and Seifert, R. W. “Applications of RFID in Supply Chains”, in *Trends in Supply Chain Design and Management: Technologies and Methodologies*, Jung, H., Chen, F. F., Jeong, B. (Ed.), Springer-Verlag London Ltd., 2007, pp. 29-48.
- Gerry Weber International AG “Gerry Weber History”, 2007, <http://www.gerryweber-ag.de>, last access on 2008-03-28.
- Gerry Weber International AG “Annual Report 2006/2007”, 2008, <http://www.gerryweber-ag.de>, last access on 2008-03-28.
- Gille, D. and Strüker, J. “Into the Unknown – Measuring the Business Performance of RFID Application” in *Proceedings of the 16th European Conference on Information Systems (ECIS 2008)*, Galway, Ireland, 2008.
- Gross, S., Thiesse, F. „RFID-Systemeinführung – Ein Leitfaden für Projektleiter“, in *Das Internet der Dinge*, Fleisch, E., and Mattern, F. (Ed.), Springer, Berlin, 2005, pp. 303-313.
- GS1 Germany “Der RFID-Kalkulator im Überblick”, White Paper, http://www-05.ibm.com/de/solutions/rfid/downloads/ROI_RFID_Kalkulator.pdf, 2005, last access on 2008-02-26.
- Günther, O., Kletti, W., and Kubach, U. *RFID in Manufacturing*, Springer, Berlin, Germany, 2008.
- Hirhammer, K. and Riha, I. “Framework for Cost-Benefit-Sharing in Logistics Networks”, in *Proceedings of the e-Business Research Forum (eBRF 2005)*, Tampere, Finland, September 2005, pp. 508-522.
- Irani, Z. “Information Systems Evaluation: Navigating Through the Problem Domain”, in *Information & Management* (40:1), 2002, pp. 11-24.
- Jain, K., Nagar, L., and Srivastava, V. “Benefit sharing in inter-organizational coordination,” in *Supply Chain Management: An International Journal*, (11:5), 2006, pp. 400-406.
- Kaplan, R. S. and Norton, D. P. “The Balanced Scorecard – Measures that Drive Performance,” in *Harvard Business Review*, (70:1), 1992, pp. 71-79.
- Knebel, U., Leimeister, J. M., and Krcmar, H. „Wahrgenommene strategische Bedeutung von RFID aus Sicht von IT-Entscheidern in Deutschland – Eine empirische Analyse“, in *Proceedings der 8. Internationalen Tagung Wirtschaftsinformatik*, Karlsruhe, Germany, 2007, pp. 89-106.
- Kopalchick, J. and Monk, C. “RFID Risk Management”, in *The Internal Auditor* (62:2), 2005, pp. 66-73.
- Lee, H., Peleg, B., Rajwat, P. J., Sarma, S., Schoonmaker, M., and Subirana, B. “RFID/EPC Benefits Calculator”, 2005, <http://ocw.mit.edu/NR/rdonlyres/Engineering-Systems-Division/ESD-290Spring-2005/F5E3F19A-7773-4CC7-A4C0-90ACFBD08075/0/EPCRFIDCalculatorMarch2005.xls>, last access on 2008-02-26.
- Leimeister, J. M., Knebel, U., and Krcmar, H. “RFID as Enabler for the Bound-less Real-Time Organisation: Empirical Insights from Germany”, in *International Journal of Networking and Virtual Organisations* (4:1), 2007, pp. 45-64.

- Loebbecke, C. "Modernizing Retailing Worldwide at the Point of Sale", in *Management Information Systems Quarterly Executive (MISQE)* (3:4), 2004, pp. 177-187.
- Loebbecke, C., Palmer, J. and Huyskens, C. "RFID's Potential in the Fashion Industry: A Case Analysis", in *Proceedings of the 19th Bled eConference*, Bled, Slovenia, 2006.
- McFarlane, D. and Sheffi, Y. "The Impact of Automatic Identification on Supply Chain Operations", in *The International Journal of Logistics Management* (14:1), 2003, pp. 1-17.
- Meffert, H., Bruhn, M. *Dienstleistungsmarketing – Grundlagen – Konzepte – Methoden*, 3rd ed., Gabler, Wiesbaden, Germany, 2000.
- Melski, A. „Grundlagen und betriebswirtschaftliche Anwendung von RFID“, Working Paper No. 11, Georg-August-Universität Göttingen, Germany, 2006.
- O'Connor, M. C. "Clothing Maker Says RFID Significantly Improves Production", RFID journal, 2006, <http://www.rfidjournal.com>, last access on 2006-08-22.
- O'Connor, M. C. "Lemmi Fashion Changes Frequency", RFID journal, 2007, <http://www.rfidjournal.com>, last access on 2007-10-10.
- O'Connor, M. C. "American Apparel Makes a Bold Fashion Statement With RFID", RFID journal, 2008, <http://www.rfidjournal.com>, last access on 2008-04-30.
- Riha, I. and Weidt, S. "Support System Requirements for an Applied Cost-Benefit-Sharing-Model" in *Proceedings of the Frontiers of e-Business Research (FeBR 2004)*, Seppä, M., Hannula, M., Järvelin, A.-M., Kujala, J., Ruohonen, M., and Tiainen, T. (Ed.), 2004, p. 364-372.
- Sheffi, Y. "RFID and the Innovation Cycle" in *International Journal of Logistics Management*, (15:1), 2004, pp. 1-10.
- Strassner, M. and Fleisch, E. „Innovationspotenzial von RFID für das Supply-Chain-Management“, in *WIRTSCHAFTSINFORMATIK*, (47:1), 2005, pp. 45-54.
- Strassner, M. *RFID im Supply Chain Management*, Dissertation, Universität St. Gallen, Switzerland, 2005.
- Straube, F., Dangelmaier, W., Günther, W. A., and Pfohl, H.-C. *Trends und Strategien in der Logistik – Ein Blick auf die Agenda des Logistik-Managements 2010*, Deutscher Verkehrsverlag, Hamburg, Germany, 2005.
- Swedberg, C. "Marks & Spencer to Tag Items at 120 Stores", RFID journal, 2006, <http://www.rfidjournal.com>, last access on 2006-11-20.
- Swedberg, C. "Hong Kong Shoppers Use RFIDenabled Mirror to See What They Want", RFID journal, 2007, <http://www.rfidjournal.com>, last access on 2007-09-18.
- Tedjasaputra, A. "Sustainable Growth of RFID Supply Chain Markets" Journal Entry, July 2007, <http://www.rfid-asia.info/2007/07/sustainable-growth-of-rfid-supply-chain.htm>, last access on 2008-02-26.
- Tellkamp, C. "The Auto-ID Calculator: An Overview", White Paper, Auto-ID Centre, 2003, <http://www.autoidlabs.org/uploads/media/STG-AUTOID-WH001.pdf>, last access on 2008-02-26.
- Tellkamp, C. *The Impact of Auto-ID Technology on Process Performance – RFID in the FMCG Supply Chain*, Difo-Druck, Bamberg, Germany, 2006.
- Tellkamp, C. and Quiede, U. „Einsatz von RFID in der Bekleidungsindustrie – Ergebnisse eines Pilotprojekts von Kaufhof und Gerry Weber“, in *Das Internet der Dinge*, Fleisch, E. and Mattern, F. (Ed.), Springer, Berlin, Germany, 2005, pp. 143-160.
- ten Hompel, M. „Die Welt der Logistik auf den Kopf stellen“. Interview, 2006, http://www.dpwn.de/dpwn?xmlFile=2006761&lang=de_DEhttp://www.strassmann.com/pubs/cik/cik-value.shtml, last access on 2007-02-09.
- Thiesse, F. and Fleisch, E. "Zum Einsatz von RFID in der Filiallogistik eines Einzelhändlers: Ergebnisse einer Simulationsstudie" in *Proceedings der 8. Internationalen Tagung Wirtschaftsinformatik*, Karlsruhe, Germany, 2007, pp. 71-88.
- Tröger, R. "Praxisergebnisse aus Sicht der Gerry Weber International AG", Beiträge zur Ko-RFID Jahrestagung 2008, 2008, <http://www.ko-rfid.hu-berlin.de>, last access on 2008-03-28.
- Weber V. and Jensen, O. "RFID Implementation in Germany: Challenges and Benefits", OECD Report, 2007.
- Wildemann, H. "Die Quantifizierung des logistischen Nutzens – Kostenausgleich und Nutzenverteilung in Supply Chains schaffen Transparenz und Vertrauen zwischen den Akteuren" in *Neue Wege in der Automobillogistik*, Günthner, W. A. (Ed.), Springer, Berlin Heidelberg, Germany, 2007, pp. 169-174.
- Yin, R. K. *Case Study Research: Design and Methods*, 3rd ed., Sage Publications, Thousand Oaks, CA, USA, 2003.