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Dag Slettemeås, Ardis Storm-Mathisen and Jo Helle-Valle

# RFID in Society
## - Preparing for the Internet of Things
## Case Analyses & Evaluation

(deliverable 2 of 4)

SIFO
Consumption Research Norway
OSLO AND AKERSHUS
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**Summary**

This report is the second of four deliverables stemming from the RCN-financed project *RFID in Society – Preparing for the Internet of Things* (2010-2017). In addition to articles, conference papers, an exhibition, presentations, media contributions and a project website, the project has published the following reports:

Del. 1 of 4: "Case Criteria & Selection"
Del. 2 of 4: "Case Analyses & Evaluation"
Del. 3 of 4: "Handbook of Methods"
Del. 4 of 4: "Final Report & Summary"

This second report provides an overview of 9 specific applications of RFID (or similar) technology used in different sectors. The in-depth cases studies conducted show diversity in terms sectors, case-study methods, application areas, and the various user and societal issues that were identified and addressed. The sectors range from *transportation* (toll collection, ticketing), *public services* (library, caring services), *leisure activities* (waterpark, festivals), *sporting events* (marathon) and *retail* (grocery, clothing/apparel).

Through these case studies, we get a richer understanding of how diverse the application areas, and associated (user/societal) consequences, are/may be in the future. It is pointed out that the case studies have been conducted some time ago (2010-2014), and today there would have been a range of other application areas that would have been relevant to study. At the same time, the cases described in this report provide a good picture of the situation in the years after 2010, when RFID was still the primary enabling technology for an IoT-vision that was scarcely treated in public discourse. Now, in 2017, IoT has become a popular topic in media and public discourse, with a range of applications and innovations on the way.

**Keywords**

RFID, Internet of Things, IoT, case studies, user/consumer aspects, pervasive technology, privacy

# RFID in Society – Preparing for the Internet of Things. Case Analyses & Evaluation (Del. 2 of 4)

by

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2017

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# Acknowledgements

This is the second deliverable in a series of four project reports from the RCN-financed project «RFID in Socity – Preparing for the Internet of things». The project was initiated in 2010, with a project period of three years. Due to unfortunate and unforseen incidents at two of the research facilities partaking in the project, the finalisation of the project has been delayed several times, with final completion medio 2017.

This second report focuses on deeper case analyses based on the findings from the first report. The project group decided that although much of the work has been performed in different time-periods, the project reports (deliverable 1 to 4) should be published at the same time. In this way, minor and major alterations could be implemented along the way in order to make the reports as connected and up-to-date as possible. This is particularly important when exploring new and evolving technologies and paradigms such as RFID and the Internet of Things.

The authors of this report are Dag Slettemeås, Ardis Storm-Mathisen and Jo Helle-Valle from SIFO/HiOA. In addition, Stefanie Jenssen (post doc, TIK-UiO), Terje Rasmussen (IMK-UiO), and Anina Sætre Bjørnhaug (master, TIK-UiO) have contributed with case study descriptions in this report.

Oslo, September 2017

Forbruksforskningsinstituttet SIFO
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# Content

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# 1 Introduction

This report is the second of four deliverables stemming from the RCN-financed project *RFID in Society – Preparing for the Internet of Things* (2010-2017). In addition to articles, conference papers, an exhibition, presentations, media contributions and a project website[1], the project has published the following reports:

Del. 1 of 4: "Case Criteria & Selection"
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Del. 4 of 4: "Final Report & Summary"

Before presenting the content of this second report, we provide a brief background of the main project itself.

## 1.1 Short introduction to the *RFID in Society* project

The project *RFID in Society – Preparing for the Internet of Things. Researching Opportunities and Obstacles in RFID innovation (or short: RFID in Society)* is funded by the Research Council of Norway (RCN) under the VERDIKT programme. VERDIKT (*Kjernekompetanse og verdiskaping i IKT*) has had a total budget of 1.2 billion NOK in the period 2005-2014. In mid-2010, 204 million NOK was awarded to 21 projects within the areas of social networks, Internet of Things (IoT) and mobile internet. The *RFID in Society* project received funding as a "researcher project" (*forskerprosjekt*) under this call. SIFO[2] has been leading the project, and TIK (UiO)[3] and IMK (UiO)[4] and SNF (NHH)[5] has been project partners. The project commenced in 2010, involved a two master projects (TIK, NHH) and a post-doc position (TIK), and was completed in September 2017 (delayed due to unforeseen circumstances).

The backdrop for this project is the rapid growth in applications for RFID[6] and sensor technology, and the emerging vision/paradigm of a future *Internet of things* (IoT). IoT has recently become a central theme in European and Norwegian ICT research politics, while RFID and other enabling technologies (sensors, actuators, etc.) are considered to be key components in a global IoT system. Advocates project vast economic opportunities and societal gain from IoT-development, while critics see enormous challenges (privacy, security, disruption, social effects, etc.) inherent in this technological move.

[1] Cf.: https://rfidsociety.wordpress.com/
[2] SIFO – Forbruksforskningsinstituttet, Høgskolen i Oslo og Akershus: http://www.hioa.no/Om-HiOA/Senter-for-velferds-og-arbeidslivsforskning/SIFO
[3] TIK – Senter for teknologi, innovasjon og kultur, Universitetet i Oslo: http://www.sv.uio.no/tik/
[4] IMK – Institutt for medier og kommunikasjon, Universitetet i Oslo: https://www.hf.uio.no/imk/
[5] SNF – Samfunns- og næringslivsforskning, Handelshøyskolen i Bergen: http://www.snf.no/
[6] RFID – Radio-frequency identification

Hence, the aim of the project was to address this situation. It set out to study how novel technologies (such as RFID) and emerging paradigms (such as IoT) can affect individuals/consumers and community/society. This implied a focus on "people-centric" applications of relevant technology and policy, while addressing both opportunities and challenges when such technology enter everyday life. SIFO had already, in late 2000, addressed the emerging consumer aspects or RFID/IoT in conferences (Slettemeås 2007a), to policy/government (2007b) and journal articles (Slettemeås 2009). At the time of project initiation, research (in particular in the Norwegian context) on individual/societal consequences of RFID/IoT was scarce, and had so far not properly addressed the socially complex and many-faceted nature of this type of technology and its relationship to social environments.

Hence, the project proposed that new approaches where needed in order to understand the role and function of RFID/IoT in society, and how this technology in the future may radically affect economic and social life. The aim was to develop several methods for studying such innovations from different practical and theoretical perspectives, primarily by identifying relevant cases to be studied (pilots, actual applications, future visions). The outcome of this research aspire to support future Norwegian research/innovation as well as policy/organised interests when manoeuvring in the RFID/IoT field.

## 1.2 Background for this report (Deliverable 2 of 4)

The first report (del. 1 of 4) described the initial task of the *RFID in Society* project, which was to identify and map *what types of technology/systems/applications* (and related products/services) the project should focus on as the "RFID/IoT territory" was relatively unchartered at the time of project initiation (2010). As part of the mapping process, the research team needed to identify *criteria* for both *selecting* cases and for *organising* them. Then the process *of selecting relevant criteria* was conducted as an *iterative process* of adding/excluding criteria, and specifying these in a *tree-shaped structure*. The next step was to identify *specific cases in the Norwegian context*. A main inspiration for how to conduct case selections and evaluations came from the *European Technology Assessment Group* (ETAG)[7] and their report "RFID and Identity Management in Everyday Life" (ETAG 2006). Our project also employed a *funnel approach*; first exploring a wide range of cases, then reducing these in terms of how relevant and typical they are for the constructed categories. Project researchers initially explored *20-30 different cases* that were tested and gradually eliminated. This iterative process of investigation and exclusion, resulted in *13 cases* to be explored further. All cases were first arranged in a *simplified template*, before a final *extended template* was developed and information about the 13 cases were entered.

In terms of methodological framework, a *case study approach* has been applied (Yin 2006), as described in deliverable 1. The strength of the case study method is its ability for in-depth examination of a case within its real-life context. Within the research framework, it enables investigation into novel topics and cases, e.g. by illuminating in our case "products" or "services" to get a better understanding of these. In the project, we focussed on particular services with a certain technology, or set of technologies, either embedded or attached. More specifically, we used a *multiple-case study* design, where all cases have been described separately, but within the same research design goal. Furthermore, the case study research strategy has been "exploratory" or "descriptive", rather than "explanatory" (Yin 2009). The goal is not to test or derive theory, but rather to acquire systematized insight for later selection and analyses. Selecting the proper cases is a critical issue to avoid cases turn out not to be viable or to represent something other than intended (Yin 2006). Hence, this initial phase of the research process is important, both to get valid cases as well as to secure efficient use of project resources.

[7] Report prepared by the Rathenau Institute, The Netherlands.

In this report (deliverable 2 of 4), we follow up the case work done in deliverable 1, and provide in-depth and encompassing studies of 9 of the 13 original cases. Researchers in the *RFID in Society*-project were assigned different cases. The template from deliverable 1 was used as a guideline and introduction to the cases, but the researchers made individual case descriptions based on their own perspectives. Hence, they differ in terms of descriptive approach and length.

## 1.3 A note on technology

In order to delimit this study it is crucial to identify the technologies that appear to be relevant for this purpose. So far, and in the project application process, we kept a relatively narrow focus on RFID (as this has been the most prevalent technology during the first decade of 2000, and the enabling technology that has symbolized the shift towards IoT). In recent years (2010 onwards), attention has shifted to include other relevant technologies. Hence, we have used the term *AIDC (automatic identification and data capture)* – a more general term – interchangeably with RFID.

The term AIDC implies systems that identify objects automatically, gather information from these, and finally enter and interpret these data in computer-aided systems. The key enabler for data exchange is some sort of data transfer technology. The most common of these are barcodes, QR[8]-codes (2D barcodes), OCR[9], RFID/NFC[10], BLE[11], in addition to biometrics, magnetic and smart cards, as well as iris and voice recognition[12]. While barcodes and QR-codes need to be scanned (e.g. with a mobile camera and integrated/downloaded scanning software), RFID and NFC implies automatic data transfer when relevant devices are within reading range. AIDC is also relevant in the Norwegian context, due to the application of this reference in the standardisation work in this area. SIFO, the project manager, became a member of the Standards Norway[13] committee *"SN/K 178 – Automatisk identifikasjon of datafangst"*[14] during the project period. This is a "mirror committee" for standardisation projects in *CEN/TC 225 Automatic Identification and Data Capture (AIDC) Technologies and Applications* and in *ISO/JTC 1/SC 31 Automatic identification and data capture techniques.* The group mandate was also to address the relationship between AIDCs (with primary attention on RFID) and other wireless and sensor technologies and networks. In addition, the group mandate was to relate this work to standardisation work within global unique identifiers and the future internet of things (IoT).

There are also other terms that embody practically the same types of technologies and functions. Still, much literature on the transfer of data from real life objects to digital systems have concentrated on radio-frequency technology. Hence, RFID has in many ways (until a few years ago) ended up as a "collective concept" for a range of resembling technologies. RFID is widely recognised and used internationally in academic, media and public debate. More recently, NFC has attracted attention as this technology has been implemented in new smartphone releases (i.e. for contactless payment and other service where smartphones are used for activating services in the proximity of the user). NFC is based on RFID technology, and data transfer can be automatically activated when reader (smartphone) and tags or other mobile NFC-devices are within a certain distance from one another. NFC demands a short reading distance and is usually practical for services that have higher demands in terms of security.

[8] Quick Response
[9] Optical Character Recognition
[10] Near Field Communication
[11] Bluetooth Low Energy
[12] Cf. Wikipedia: https://en.wikipedia.org/wiki/Automatic_identification_and_data_capture
[13] http://www.standard.no/en/
[14] https://www.standard.no/standardisering/komiteer/sn/SNK-178/

More recently focus has shifted from these enabling technologies to IoT. A 2016 report by Rathenau Instituut[15] ("Beyond control: Exploratory study on the discourse in Silicon Valley about consumer privacy in the internet of things"), addressing the "hyper-connected consumer", lists the key technological elements of IoT[16]:

- *sensors* (give things context awareness, ability to collect data)
- *actuators* (enable things to perform actions in the physical world)
- *processing units* (on chip, give things capability to do small computing on collected data, operate without human intervention)
- *unique identifier* (ensures that things can be identified and found in the network)
- *communication and network technology* (connecting things to the internet, or to local network/gateway device between thing and internet)

In the *RFID in Society* project, we will mainly focus on RFID and NFC[17] (in addition to QR-codes and GPS), as well as IoT as an overarching technological system that employs these enabling technologies.

[15] Cf: https://www.rathenau.nl/en/publication/beyond-control
[16] Cf. p. 4: https://www.rathenau.nl/en/publication/beyond-control
[17] NFC has been relevant in terms of the *NFC City* project that has run in parallel with the *RFID in Society* project, and in which SIFO has also been a project partner.

# 2 Case 1: Autopass – toll road collection system

**Case study 1**
**Responsible researchers:** Ardis Storm-Mathisen, Jo Helle-Valle & Dag Slettemeås (SIFO).
**Time period:** 2012-2013

**Case study method**
Data on how the technology was discursively presented by suppliers and understood by users was gathered through online and offline desk research. This included available reports, documents, newspaper, online debates, blogs and interviews from implementation until present. In addition, data on user practices was gathered through a small in-situ fieldwork that consisted of photo/video assisted observations and interviews (inspired by Pink 2004), riding/walking-with four AutoPASS and four Travelcard users on an everyday travel in fall 2013. The fieldwork provided the analysis with data where the discursive could be analysed as elements in wider, practical enactments of *doing travel with RFID*. It also provided discursive data on user experiences with the systems that came *before* the RFID implementation.

**Introduction**
AutoPASS is a relatively mature RFID system with a long track record. Mass-market implementation goes back to 1991 in United States. In Norway, it was introduced in 1998 to collect tolls on roads in Oslo and has since been implemented on almost all Norwegian toll-based highways. The main actors are Q-free (developer), Vegdirektoratet (owner) and Fjellinjen (toll collector). Before 1998, tollbooths were staffed or had automats where drivers had to stop and pay with coins/notes or credit card. From 1998 to 2008, cars with AutoPASS could drive through toll stations without stopping, whereas cars without AutoPASS had to stop to pay manually. Since 2008, all traffic payments were fully automated to *enhance traffic flow* and to achieve *more efficient collection of toll fees*. In 2014, a new chip (smaller and with longer battery capacity and a more EU compatible standard) is to be implemented.

**Technology and functions**
The AutoPASS piece placed in cars is an active contact-free, battery-enabled tag (Q-free – DSRCs)[18]. It constantly emits signals, can be read at high speeds by long-range passing readers, and stores 100 entries from each car. The system uses decentralized databases, and registered users can access their profiles online. Payments are automatically controlled by an assistive camera taking pictures of cars that pass without an RFID chip inside, which are deleted later when control is ended. A review of public documents and supplier presentation of RFID to customers show that AutoPASS had automated payment/travel passage as their original purpose and main function. For AutoPASS, reducing staffed tollbooths was cost reducing and aimed at improving traffic flow and customer service, as cars did not have to stop to pay and each passage was noted on the bill.[19]

**User perspective**
The user of AutoPASS technology may be a citizen/consumer or visiting adult who owns/borrows/rents a car. Below we address the user perspective regarding AutoPASS chips, by framing

[18] Dedicated Short Range Communication
[19] http://www.AutoPASS.no accessed10.02.2012)

it analytically within the domestication theory perspective (Silverstone et al 1992, Lie and Sørensen 1996, Berker et al 2006, see also Storm-Mathisen 2014). According to this perspective, the adoption, or domestication, of a technology/artefact/service undergoes four different, non-discrete/non-linear adoption phases; appropriation, objectification, incorporation and conversion.

Appropriation: Users come to possess AutoPASS by signing an AutoPASS contract and ordering an AutoPASS On-Board Unit (OBU-RFID tag) online from AutoPASS or at a gas station. The tag has a small deposit and is delivered by mail. Car drivers with an AutoPASS tag receive a 10 percent reduction of the toll collection price. Cars passing without a tag have their registration plate photographed and receive a bill in the mail. In this study, a mini ethnography enabled the researchers to follow a mother of two children, a father of two, a grandmother living in the Oslo Region (all of whom had installed AutoPASS in their cars), and a young man living outside Oslo (who did not have an AutoPASS chip). All our informants with an AutoPASS had used the online option and received the tag by mail without problems, although they had to go to the post office and experienced a delay between purchase and receipt.

Objectification: The AutoPASS tag is a plastic white flat square box that the user must install inside the vehicle on the windscreen behind the mirror (out of user sight). The ID on the tag is registered to the car license plate and is not meant to be transferred between cars. The AutoPASS has adhesive tape on the back and is easy to attach. All our informants with AutoPASS had installed the tag correctly without experiencing problems. After the tag is installed it "disappears", i.e. it is rendered invisible to the users as they do not have to engage with it, unless there are problems, or if the tag needs to be replaced (if broken, or need update).

Incorporation: Since the tag does its work automatically, our informants did not have to interact with the technology nor reflect on it during their everyday driving, as noted above. All users with a tag did however know that the tag was in the car and where it was located. They also indicated that they knew what it was, but said that, once installed they took it for granted, forgetting about it most of the time. Hence, the AutoPass tag quickly became incorporated into the everyday routines of users.

Conversion: Since the RFID tag and reader technologies (or camera) at passage points and payment services are automatic, it is the *technologies that interact*. The user as subject is furthermore little involved in communicating about the technology to the outer world (apart from doing the driving that enables the technologies to interact, possessing an ID as owner of the car that passes and as the person receiving and paying bills for passage). The only visible sign is that other drivers can see whether cars that pass have prepaid or not, as those who have paid receive a green sign (those who have not paid, or are late on the pre-payment, or who does not have the RFID-chip, receive a yellow sign). There could be some social stigma attached to the "yellow sign", but this was not investigated further. The informants made no connections between the AutoPass technology, their possession/non-possession of it, and their status and social belonging in general, and one had discussed the technology much with other peers.

Although the initial appropriation and objectification involved some interaction (ordering online, picking the tag up at the post office, installing it in the car), very little 'taming' seemed to be necessary for our informants to make the AutoPASS "their own". It required no competence to use (except driving and paying the bills) and there were few differences in experience and practice of incorporation and conversion among the users. In comparison to practicalities involved in travelling on toll roads before the implementation of AutoPASS, the practice of driving a car on the toll roads appeared to have become less demanding; i.e. no stop was required, no need for credit cards or cash to travel.

Ever since the mature stage of the AutoPASS was reached, cars have been able to drive through tollbooths without stopping, regardless of whether they have appropriated and installed the

AutoPASS in their car or not. Thus, the pimplementation of the RFID technology has somewhat made the passing of tollbooths more convenient, *both* for users who have appropriated the RFID chips *and* those who have not; either way the actual payment does not matter much for *the practice that is required* to pay the toll. The only difference is the toll cars pay 10% less with AutoPASS, and that they receive a green sign when they pass.

**Societal aspects and controversies**

There have been few controversies about the primary functionality of AutoPASS, but there have been some concerns about privacy, surveillance and function creep (i.e. the tendency to add more functionalities). Both individual consumers and The Norwegian Data Protection Authority (Datatilsynet) have voiced concerns about the kinds of data AutoPASS harvests, how these data are managed and for how long information is kept before it is erased (100 recent passage information items are retained). The Data Authority has also raised concerns about the impossibility of anonymous passage and the prospect of (unauthorized) third party readings.

The potential and actual likelihood of function creep after implementation has also stirred various controversies, for instance with respect to taxation control, insurance, traffic management and control, (un)authorized value-added service creation, as well as mapping passage patterns and surveillance (e.g, police use of passage data as evidence in trials). Events triggering debates on these issues have been associated with criminal investigations, where AutoPASS data on vehicles or persons could be released to police or tax authorities, as well as with controversies about the use of such technology in the international arena (border crossing, etc.ETAG 2006).

# 3 Case 2: Skien Fritidspark – indoor waterpark

**Case study 2**
**Responsible researcher:** Dag Slettemeås (SIFO)
**Time period:** 2012-2013

**Case study method**
In the case of Skien Fritidspark, an indoor waterpark, the researcher made several visits to the waterpark in 2012 and 2013. In addition, a visit was paid to the Drammen indoor waterpark (which does not feature the RFID wristband). This was done to compare the various functions (traditional vs RFID-enabled). A participating observation approach was used, where the researcher, family and others consumed the various services offered at the waterpark. Hence, the researcher used both his own participation, in addition observations and talks with others, as a method. Furtheremore, photos were taken of the various service points where RFID-tags were used. This was both to get more detailed information to work with later, in addition to use illustrations in the descriptive case study analysis.

**Introduction**
The reason for choosing this indoor waterpark was that it had launched a fairly complete RFID-system for its users, solving many of the hassles often occurring in waterparks, where it is difficult to carry around keys, wallets, etc. Hence, for comparative purposes, the researcher visited a similar waterpark in Drammen, Norway, where there was no RFID-system in use. Here, the users of the park first needed to pay to enter the facility. Then they needed coins to pay for lockers to store clothes. In the pool area, the users needed to bring the locker keys (with a rubber band to attach to arm wrists or ankles). If purchasing something at the pool café one had to go back to the locker/changing rooms to pick up the wallet from the lockers – and then return to the locker room with the wallet after purchase. This is all very inconvenient for the user, who wants to bring as little as possible into a rather damp and wet environment. In the case of the waterpark in Skien, these issues were all addressed with the new RFID-system.

**Technology and functions**
The RFID-device that users are equipped with contains a short-range RFID-chip embedded in the rubber-coated, water-resistant wristband. There are two types of wristbands; one for adults and one for children (separated by different colours). The main reason for this is that the adult wristband allows for credit storage. The wristband is only activated when it is very close to the various readers, hence the wristbands do not radiate constant signals. The various functions that are part of the system is integrated access/ticketing (and exit), locker access, and payments system for cafes. These are the three main features needed when visiting the waterpark. In this way there is no need for coins for the lockers, and no need for wallets in the café area.

The different RFID readers are found;

1) at the entrance (tapping the wristband to open the barrier)
2) at every locker door in the locker/changing area;

3) at the POS[20]-terminal in the café;
4) at the payment terminal near the entrance (where the wristband is tapped to access the amount used at the café, which then is the paid by debit-card at the terminal)
5) at the exit where the wristband is tapped at the barrier, and a small box opens where the wristband is entered. When the box is locked, the barrier opens and the customer can exit.

In addition to this, for yearly subscribers, there are more profile data entered in the database. It is not clear to the researchers whether this means more functionality to the customer, or if it is merely a security feature – as yearly subscribers can bring their wristbands with them home.

**User aspects**

In terms of user aspects, the RFID-wristband is clearly a service that seems to benefit the users (although it probably increases efficiency for the suppliers as well).

**Image 1: RFID wristband/ Photo: SIFO**

The wristband is personal and is carried by the users at all times, and is also highly visible (green and blue colors). This also made it easy to distinguish the children's bracelets from that of the adults. This was highly important, as only the adult bracelets included the payment function.
In this way the RFID functionality is something that the user engages with several times in the waterpark facility; it becomes highly visible and interactive, and seemed to spur curiosity especially among the children, who were amused by the shear "tapping experience" (the contactless feature). The children were also in a way empowered by being given responsibility for their own wristbands, and this led to a sense of freedom and control when being at the waterpark.

However, there was no identity/identification function, which has been tried at other amusement parks in Europe and the US, where children can be tracked by the RFID-chip in their wristbands. This could have created a sense of increased security among parents, but at the same time the waterpark is smaller than most amusement parks, and hence more transparent. By leaving out the tracking feature, the waterpark also avoids the controversy that has been affiliated with such wristbands at other parks[21]. At the Legoland park in Denmark for instance, active RFID tags (with an onboard power source as opposed to passive tags) was tested in mid-2000 for tracking lost children.

**Image 2: A child with the green bracelet letting himself in by tapping it at the RFID-enabled barrier/ Photo: SIFO**

[20] POS = point of sale
[21] Cf: http://www.networkworld.com/article/2332669/network-security/legoland-uses-rfid-for-finding-lost-kids.html and https://singularityhub.com/2010/09/15/in-the-debate-over-rfid-tracking-children-are-the-testing-ground/

As a partly comparative practical study was conducted between the indoor waterparks in Drammen and in Skien, the user *convenience and efficiency* aspects became very apparent. The first study was done in Skien (with the RFID wristband), and hence this was the "baggage" the researcher (and family) came with when visiting Drammen. As the users had already gotten used to the wristband, it became apparent that going back to a "traditional system", was perceived to be very inconvenient. The group lacked the right coins for the lockers and had to change at the entrance, after entering the locker area. Keys for the lockers had to be carried somewhere (attached with rubber band around ankles). When going to the café, the adults had to get back to the locker/changing area to get the wallet, then return to the café to purchase products, then return to the locker to leave the wallet. The payment system was the most inconvenient one, and just the notion that all these functions could have been integrated, added to the negative experience. It might be that the group in the field study would have perceived this differently had they not visited the Skien waterpark first.

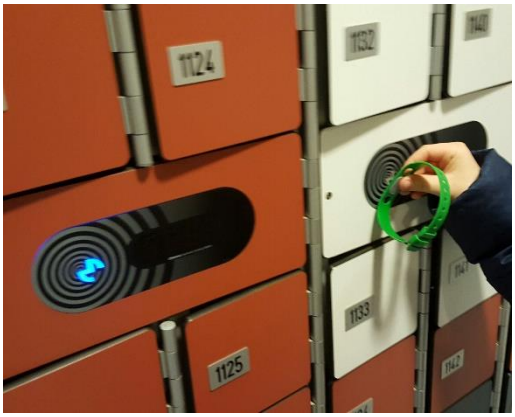


**Image 3: RFID bracelet tapped at the locker door to open/close/ Photo: SIFO**

So, on returning to Skien, the convenience of the integrated functions offered to the user through the RFID bracelet became highly apparent. At the entrance, the whole family and other visitors joining, could operate on their own, enter the facility, changing to swimwear, and enter the swim area/waterpark without bringing other means than the wristband. When a full day at the waterpark was over, everyone could operate on their own, and meet up at the payment apparatus right by the entrance. Here the adults presented their wristbands, tapping them at the black circular field below the touch screen. The price of the items bought at the café, and the total price, was shown on the screen. The amount could then be paid by the entering the payment card and the pin further



**Image 2: Payment machine with touch screen, RFID reader and payment card function / Photos: SIFO**

down on the payment machine. Hence, summing up the convenience/efficiency/customer satisfaction factors for the user; removal of physical ticket, locker keys and personal wallets, as one bracelet integrated all these functions in a water resistant (rubber sealed) RFID wristband.

**Societal aspects and controversies**

In the case of this RFID-enabled system that integrates several user functions in one device, few societal aspects are addressed. This is a "closed" system that only operates within the premises of the waterpark. After the customers leave, bracelets are left behind and not brought home. There are no added features (yet) that would indicate potential for "function creep", and it is only yearly subscribers that have a profile and who bring the bracelets home. There could potentially in the future be new functions added, including integration with other local services in the vicinity. With this (only a scenario described by the researchers), there could be potential for more profiling of users, involvement of third parties, data transfer between services, location tracking and marketing/loyalty potential. Hence, services could be tailored for a geographical area, involving i.e. several amusement services, accommodation, restaurants, etc. in a local or "mini-IoT", where user data are processed in real-time for enhanced services to the customers.

# 4 Case 3: Deichmanske bibliotek/Oslo universitetsbibliotek –libraries

**Case study 3**
**Responsible researcher:** Terje Rasmussen (IMK, UiO)
**Time period:** 2011-2013

**Case study method**
The study is based on an assessment of the conversion to RFID in 2011-2013 at one academic and one public library in Oslo – the Oslo University library (Department for the Humanities and the Social Sciences) and Deichmanske library (Oslo's municipal library). It is also based on Scandinavian experiences evaluated in several studies. The case study furthermore involves a field study at the libraries (observation and participation), as well as interviews with key respondents affiliated with the libraries and library policies.

**Introduction**
Libraries were among the first institutions that introduced RFID in their regular services. The first libraries implemented RFID in the late 1990s. Libraries use passive tags enclosed in the book. The frequency used is not reserved for libraries (13,56 MHz) but the tags are for libraries only. The Norwegian standard is based upon the Danish standard (DS INF 163-1-2005), with an addendum listing the Norwegian profile. RFID was implemented in Silkeborg library in Denmark as early as 1999 on an experimental basis, several years before any RFID/library standard was established. A Danish standard for RFID in libraries was set in 2009 based on various ISO standards. The Danish standard follows international standards in order to ensure as low cost as possible, and to make the libraries independent of singular suppliers, and also to ensure interoperability between libraries. The Norwegian profile was produced by an RFID-group consisting of members from various relevant organisations.

**Technology and functions**
In libraries, the tags may read signals from up to two-three meters range. Books are lent out by putting them close to a reader, which register the book immediately, regardless of the location of the tag. The operation can be initiated by the customer, which relieves manpower at the libraries for other useful purposes. The reader is interconnected with the library system through dedicated software, and instructs the library system about the status of the book/CD and de/sets the alarm.


**Image 1: Source: http://www.rfid-library.com/**

Another approach is a hybrid solution with both pin-codes and RFID. The disadvantages with this solution are the risk of confusion for users, since they may not know what is for what. The RFID tag in the book contains ID-information about the item, country, library, and other codes indicating the item, and it eventual parts (CD-collections), and alarm.

So far RFID serves as:

1) A system for the status of singular objects: (Is it loaned, has it been returned, has a reminder been sent, how many times has it been in use?, etc.)
2) When accumulated, this data gives automatically valuable information about patterns of behaviour.
3) For the user, the RFID is either like any other paying card, or as an "invisible", integral part of the object. The latter is the case with libraries. Although the RFID-chips/ antennas are attached to books with stickers, these are not removable and are most likely perceived to be "part of" the book by its users.

Generally, RFID is often introduced for security reasons. That was not the case with the two library cases studied here, since alarms were already attached to books, and the zip-code system also kept track of borrowers who did not return books. The reasons for introducing RFID are more pluralistic and indirect, and thus sometimes more difficult to see. In fact, at first sight the advantages would not balance with the costs of introducing the system, at least not in libraries with a zip-code system in place.

**Motivations for using RFID**

The primary purpose for introducing RFID in our two library cases were to release labour power, which then could be used for other purposes such as extending opening hours. To authorize borrowing of books are not considered a high quality work among librarians, and they would prefer to spend more time with more rewarding tasks, and tasks associated with higher status. RFID registration by the loaner herself involves time saving, for the loaner as well as for the staff. Also, the control over the collections increase, as misplacements easily can be detected with a shelf reader. This reduces the means spent to buy replacement copies. In general, if libraries can find money to do the actual chipping/tagging, they calculate that recourses will be saved in long term at the same time as a foundation for future services has been laid.

Although the technology is hardly new, it has yet to be implemented in many libraries. This is due to the high entrance cost associated with the chipping/tagging. This is a considerable task for many public libraries in terms of cost and time. Furthermore, it has been expected that the price of tags would decrease along with technological development, a fact that encourages postponing of implementation. Also, other practical problems have been addressed, for instance regarding tagging of audio-visual material.

The tagging/converting process can be done quickly or over longer spans of time, depending on a number of conditions, for instance whether the library can be closed during working hours. For instance when the main Deichman library building was closed for rebuilding after the 22. July attack in Oslo, the library quickly decided to redirect its staff towards tagging books. The building was damaged as a consequence of the bombing of the government building at the centre of Oslo. However, there are different conditions at different affiliate library branches. In all cases, knowledgeable planning is of course essential. The main Deichman-department decided to begin with the Music department since CDs and DVDs (books, music, films) were considered to be particular challenges (different tags need to used and all records in a package also need to be tagged. Furthermore, there are few new CDs and DVDs coming in to the library as these formats are to be replaced by online solutions.

In order to finish the work as quickly as possible it is not necessary to tag all items, only selected departments or even only the most popular items. Some libraries postpone the tagging of the stored books, while others tag all journals or prefer to wait. During the process at the two cases studied here, the existing barcodes on the books were removed from all books in the tagging operation, even if this was not considered necessary. The reason for this operation (that complicated the process) was simply that it was decided not to risk interference complications between the two (light- and radio-) wave technologies. If the library discovered post facto that all barcodes needed to be removed from the books, the whole process (involving every single book) would have to be repeated. This delaying procedure illustrates well the insecurities associated with this technology.

There are few or none hesitations or post-facto regrets about investing funding and many work-hours in tagging discs and books. Increasing self-service is considered an advantage for all parties, and the cost-savings are considerable. The flow and control of items in and out of the library appear flexible and simplified. However, the flow of items between libraries are not yet influenced by RFID.

**User aspects**

In this case study we have primarily focussed on the "back-end"; the motivations and functions that RFID provides to the libraries. However, the service itself, the loan of books, CD, DVDs, etc, is highly relevant to the user – and the RFID changes how users interact with libraries and library items. The main changes that come with the introduction of RFID in libraries is increased *self-service* for user. They can find books (and other items), take them to the check-out machine, pile the books (no need for scanning individual items), and the RFID tags are immediately identified and registered by the machine. All the books are displayed on the screen, and the user can control that all items are registered. At the same time the alarm function is de-set, enabling the user to exit the library without engaging with staff.

The user then brings the RFID-enabled items home. However, the RFID-labels are not very visible, and the users will most likely only engage with the book as an artefact, and not the RFID technology. When returning the books, the same self-service opportunity is provided. The items are places in the opening of a check-in machine, and all items are registered one by one, and a small conveyor belt move them away to safe storage. Hence, to the user, the main difference lies not in the engagement with a new technology, or with new functions added by this technology, but rather the self-service factor that empowers the user to do whole loaning process on his/her own. This implies, to many, increased convenience and efficiency, and could also reduce queueing at manned counters. For those that are not comfortable with self-service, librarians function as back-up assistance.

**Controversies and potential functions**

Currently, RFID in books undertake more or less the same functions as barcodes, only quicker, safer and more robustly. In this current phase, there are few controversies and resistance, even though the labour and recourses necessary for chipping or tagging every book are large and

time-consuming, and there are some issues in terms of making the librarian function redundant (i.e. 24 hour fully self-serviced libraries). The concept of "Open library" means that the library can be more or less unmanned, and that customers may enter 24/7 with an ID-card, and RFID could be used for self-service loans, entry/exit, information display, etc.

In a next phase, the RFID technology could potentially be used, in ensemble with the library identification card and other technological changes, to establish new services. There is a possibility that libraries could actively provide customers with information about particular books, offers and other sorts of information about promotions or events in the library. Then the library may distribute its information to selected groups of customers according to their reading habits and interests, based on book and other item selections. To personalise information is becoming a favourable way of spreading information in order to utilize the stream of information generated from user habits. With RFID, groups of users can be detected regardless of who they are, but rather based on how they use the library.

Based on this, there could also be developed in-aisle companion solutions ("intelligent shelves"). For instance, users could be identified through their smartphone, user profiles and previous loan habit analysis could be activated, and information could be sent to users' phones. Or, users could themselves scan RFID/NFC stickers placed in libraries to get enhanced information or "experiences". In junction with an ID-card, the registration of borrowing and returning could even take place at the shelf, without any portal or automat. Also, books need not be placed according to any particular system, but only according to access. The RFID shelf-reader may locate all books easily.

**Societal aspects**

Along with the digital society, the share of printed and other material products will stabilise. It has been debated how much resources are to be invested in "physical" material when digital collections become more important. However, we should not draw the conclusion that material products will occupy only a minority of library working-hours and resources. The material collections (books, CDs, journals, etc) take up much space and are considered as the core of the library material. They require considerable attention and will continue to do so in coming years. RFID tagging will release resources for other operations regarding the digital material. Consequently, rationalisation and simplification of the handling of material products are seen as a necessary strategy to meet the digitalisation of public information. Another effect is that process of tagging gives the additional opportunity to reconsider the exemplars in the collections.

However, as mentioned, the transition to RFID-based handling of printed and CD material requires considerable investments in work-hours and equipment. The libraries therefore needs to plan the transition carefully with regards to selection of types of equipment and suppliers, timing of investments, the degree/ambition of the transition, compatibility to library systems and logistics concerning the actual chipping/tagging. In addition there are considerations about potential privacy concerns if RFID and "big data" are used for enhancing customer services in the future (using user profiles, reading habits, location data, and so on).

For some libraries there are no immediate hurry, as they have introduced barcodes and self-service automats for loan and return already. The constant dilemma here (as for nearly all current high-tech investments) is that innovation runs fast and there are always new solutions underway. RFID will be improved, and ultimately replaced by other systems like Near Field Communication (NFC) connected to the mobile, which already contain a virtual library ID. So - when to wait and when to act? A probable scenario is to convert to RFID when current barcode labelling needs to be replaced anyway. Due to the necessity of new systems and the high investments there seems to be no going back, only going forward.

*Short-term effects of RFID*

Quite often the RFID implementation strategy rests on two expectations to the library as a social institution; a) that it constantly seeks to reduce thresholds for using the library, and work out scenarios for a significant and meaningful role for the library in its social context; b) that it does so without calculating with extra funding, and that the number of staff will no longer increase: The way out of the dilemma is often digital technology, and present-day development relies highly on the idea that digitalisation is the future for the information society.

One important factor is whether the library already has a barcode system in place already. If not, the advantages of RFID are decisive. If an efficient barcode system exists, the short-term needs are not the same. It must be remembered that barcode systems are well tested and perform almost all the services that RFID provides (at the current stage). Other potential disadvantages that need to be considered are costs, particularly of tags (RFID-prices are likely to decrease in coming years) and the tagging operation (staff costs). Another problem is the lack of exemplar identification, which has led some libraries to keep the barcode system.

**Image 2: Source. http://www.rfid-library.com**

On the other hand, barcode systems are more expensive in the longer run due to needs for replacements. To reinvest in barcode systems in the future may seem a too conservative approach. They also have problems with handling AV-media. Suppliers are likely to invest in improved RFID technology in the coming years. Compared to barcode systems, RFID-automats allow the users to receive more information about previous loans, etc. The risk of errors is small, the operations at the automat are quicker and more flexible (not least for disabled persons), since the automats can handle at least six books at the time. Possibly most important, the potential for future user-oriented services are considerable.

Currently, development work is done with regard to a suitable RFID solution for mobile loan units (book busses). This requires a self-service reader that is online and in connection with the library system. Other challenges relate to the needs of special groups. Experiences so far suggest, however, that RFID is not a particularly difficult system to handle for i.e. elderly people, as it relies on intuitive user interfaces, automation and touch screens (the latter could be a problem for visually impaired people due to lack of tactile user interfaces).

*Long-term effects of RFID*

Norms and attitudes towards digital identification technologies depend much on questions of complexity, visibility, information, marketing, etc. Another key factor would be the experiences of early users. The introduction of RFID should best be assessed when viewed as an *information system in a wide sense*, not only based on circulation of information about books and CDs, but also including, signs and information, staff attitudes, customer competence, marketing, etc. Whereas the visible aspect of the system would be the self-service terminal, this is only the "tip of the iceberg." Furthermore, the RFID information system (including the established library system, such as BIBSYS) is intimately linked to important elements of the organisation, such as the number of staff, opening hours, collections and magazine storage and the profile of user groups.

"The intelligent shelf" may in the future mean that the user automatically is guided towards the location of the book/CD (blinking light), or that wrongly placed books signals their position to

the staff. By reducing the need for full-time staff, local libraries may be saved from shutting down, and staff could be used for customer-centered services. Such solutions may also be of help to persons suffering from dyslexia or reduced eyesight. Tagging in library walls and floors may in the future guide users towards the right shelf and book.

Another aspect related to the transition to RFID in libraries concerns non-technological, indirect effects. The planning of the transition often leads to an extended strategy concerning a wide range of related aspects. Customer service, general design and atmosphere of the rooms, improved working routines and competence among the staff are some elements, which seem to be actualised by the RFID process as a catalyst. It is therefore important to map the flows and circulation of users, books, services and staff and analyse these as a whole. The RFID process should also leads to widened thinking about how barriers and bottlenecks can be eliminated and adjusted to various groups of users (universal design).

This means that the decision to tag the books and other items in the library should not simply rest on the annual number of borrowed items, but ought to be viewed as one component of change among many others. The potential of RFID will be more fully realised if other aspects are adjusted accordingly, such as reprioritising work, reconsidering opening hours, rearranging interior design, enhancing information to the public, etc.

*Privacy*

The "big" questions regarding privacy and professional integrity has been addressed in Europe already as digitalisation has developed, but will increase exponentially when RFID-technology, NFC-enabled smartphones, and other "connecting" technologies and "connected" devices expand in a coming "internet of things". "Smart libraries" will be part of this transition to a "smart" or "connected" society. Today, there are limited connections between user profiles, loan patterns and other services and data analyses, and the integrity and anonymity of users is safeguarded in the library sector. In the longer term, prospects may be quite different depending on politics and further development of consumer and personal privacy rights. Much attention is given to these questions both in Europe and in the US; for the latter in particular in the wake of the "Patriot Act". Thus, RFID as a small identification and connecting device, probably marks the beginning of transition towards a more location and identification technologies being deployed in society, related to both humans and materiality, linked to LANs, closed networks and the Internet. The reason for this is that our modern world is increasingly influenced by advanced systems of information flows, concerning logistics of objects.

This development will be followed by a public debate weighing advantages of the system and the obligation to follow European policies on the one hand, with problematic issues such as privacy on the other. Following other debates on privacy, the organisation AIM-Global argues for certain basic rights for the individual concerning RFID: Consumers should have the rights to know why, where and how tagging are applied, have the possibility to reject/ignore RFID, access to information embedded in the RFID system, and to have the information deactivated after purchase. Of great importance is the fact that the tag itself does not contain any detailed information about the item or the user, only an identification number that can be connected to a particular book or disc. However, if the user is also to take care of paying depths etc., The RFID system needs to be connected to the library system (BIBSYS).

Concerning safety, this aspect relates to many different levels. A general principle for securing privacy is that data sets and databases should remain separate. In other words, information about users should not be linked to series of loans, in order for individual loans over time to be mapped and loan profiles of identified individuals to be processed and transferred to external authorities. It is also a question to secure databases from external tapping and merging. This concerns the chip and server technology, data and software. So far, problems concerning Identity Management has not been actualised in libraries. With Identity Management, we mean how users of an information system have control over personal information about themselves in the

system, which may be accessible to others. Due to the widespread and increasing debate concerning privacy in digital networks, private and particularly public institutions have been cautious about connecting RFID information to information about the users/clients. The potential controversy regarding RFID and privacy would, at least for now, be more pressing in areas like commerce or healthcare.

# 5 Case 4: Flexus/Ruter – Oslo/Akershus public transportation

**Case study 4**
**Responsible researchers:** Ardis Storm-Mathisen & Jo Helle-Valle (SIFO)
**Time period:** 2012-2013

**Case study method**
In this case study the researchers base data is collected by way of desk research/archive search on the internet, identifying available user discourses. Furthermore, a customer test was performed in addition to four separate walk-along interviews with users, where users performed routine tasks when engaging with the RFID-technology/service. In the brief case analysis section, we apply the domestication perspective (as with the Autopass case) as a way to analytically describe how users engage with the service/technology, and lastly combine this with the perspective of Actor-network theory (Latour 2005) to address how the travelcard was implicated in 'assembling the social' in new ways (see also Storm-Mathisen 2014).

**Introduction**
The RFID-based electronic ticketing system in the Oslo public transport sector – the Flexus/Ruter Travelcard – was planned to start in 2000 under the name Flexus (after a pilot test among students in 1997). The main actors were Mifare DESFire/NXP Semiconductors (developer), Oslo commune (municipality) and Akershus Fylkeskommune (regional municipality) (owners) and Ruter AS/NSB (service provider/payment collector). Technical and organizational problems delayed the introduction of the Travelcard to 2009/10 and two parallel systems were in operation for some time. In 2011, the name and design of the Travelcard was changed from Flexus to Ruter, but the technology and opportunity to buy tickets remained the same. By late 2012, all public transport in Oslo/Akershus was using the new Ruter RFID-based ticketing system. In 2013 an app to purchase and validate tickets on smartphones was introduced.

**Technology and functions**
The Ruter Travelcard is an RFID-based ticketing service with payment/access/validation control as core service functions. An RFID system generally consists of RFID tags (transponders), readers (transceivers), and information that are identified, collected and transmitted to central databases. The type of RFID used in the Flexus/Ruter Travelcard is a passive, battery-assisted contactless smartcard, using short-range RFID (less than 10 cm [Mifare DESFire]), which means that it needs to be in close contact with a validator to read information. The system uses decentralized databases, and registered users can access their profiles online. One key difference between these technologies and previous ticket systems, is the contactless or automated reading/validation.


**Image 1: Ticket purchasing machine at station (Photo: SIFO)**

**Image 2: Ticket validation machine at station (Photo: SIFO)**

In the case of the Flexus/Ruter smartcard the card must be loaded with a ticket before entering public transportion. The ticket is activated/validated when placed over a reader automat/validator at a station/platform and/or inside a vehicle/boat. In contrast to the RFID product group where objects are *tagged with RFID* (clothing, books, etc.), the Flexus/Ruter belong to a product group where RFID is a *central feature of the object*. Boslau and Lietke (2006) suggest that the product group where RFID is a central feature represents a *core value for the consumer*, while RFID-tagged items essentially provides added value to producers and businesses. However, as the Flexus/Ruter Travelcard case will illustrate, the value for producers may be greater than the value for consumers also when RFID is a central feature of the product.


**Image 3: Sign with ticket purchasing instructions (Photo: SIFO)**


**Image 4: disposable ticket and receipt (Photo: SIFO)**

A review of public documents and supplier presentation of RFID to customers show that the Flexus/Ruter Travelcard had automated payment/travel passage as its original purpose, the main functions where; to ease and speed up the process of purchasing a ticket, to generate better information about travels, and to reduce the incidence of non-paying passengers. As elaborated below, these purported benefits generated by/from the supplier side were experienced somewhat differently by the users in the case study.


**Image 5: Refilling smartcard ticket at kiosk (Photo: SIFO)**

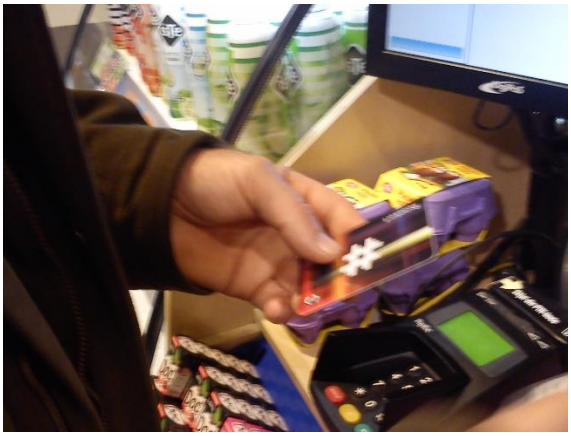

**Image 6: Paying for smartcard ticket refill at kiosk (Photo: SIFO)**

**Controversies in public debate**

In the case of the Flexus/Ruter Travelcard, the controversies and public debates were considerable. These were related to the continuous technical and organizational problems experienced with Flexus from its early piloting in 1997 until its full implementation in 2012 (Krogstad, 2010), resulting in high costs, delayed implementation and that a paper-based ticket system had to run in parallel with the RFID system from 2009-2012. Datatilsynet (The Norwegian Data Protection Authority) also voiced privacy concerns and demanded Flexus to delete person identifiable information 30 days after the expiration of a ticket. Flexus harvested more travel data than was necessary to bill, administer and respond to customer complaints (all data - 8 last passages on a card, stored for 10 years) and planned for a complete surveillance system of passenger traffic (camera surveillance on all stations, inside vehicles, and combined with passenger cards registered and read at all passages [entry and exit]).

There were also serious user problems as travellers found it difficult to control the validity of their Travelcard. Furthermore, most customer service functions (i.e questions and complaints) had been moved from human-human interaction to human-technology interaction, while prices on tickets had increased. Also, technical problems persisted after implementation; short life of tag batteries, readers that did not function, and investments in stop-control-bars at larger stations could not be put to use for safety/escape reasons.

Public discontent about Flexus grew stronger and Norway's leading newspapers published several articles portraying the Flexus-project as a "catastrophy" and "public scandal". The negative association with the Flexus name resulted in a decision to change the name of the Flexus Travelcard to Ruter in 2011. Although controversies around the technical solutions, prices, travel control and surveillance/privacy issues decreased after 2012, discontent linked to the low user-friendliness of the Travelcard continued. However, the implementation of the *Ruter app for smartphones* in 2013 improved the user-friendliness of purchasing, validating and keeping track of electronic tickets and the controversies diminished.

**User aspects – domestication of RFID by users in public transportation**

This section looks at the characteristics of practicalities involved in the use of the Ruter Travelcard (with a glance to previous systems). The analysis is structured using the conceptual tools of the domestication processes (cf. Silverstone et al. 1992, Silverstone and Haddon 1996). Table 1 at the end of this section provides a sketch of the main features of this discussion.

The potential user group of the Flexus/Ruter Travelcard includes every citizen and visitor to Oslo who needs to use public transportation: children, youth, adults, the elderly, the disabled and so on. Hence, the functions and design of the service needs to be tailored to fit a heterogeneous mass of users (including universal design features). In the mini-ethnographic fieldwork in this case study, we followed a female student, a grandmother, a mother with a young daughter, and a teenage boy travelling on public transportation. The teenage boy and female student had a prepaid 30-day ticket, while the others had coupon cards.

***Appropriation:*** (the initial taming, adoption and meaning-making phase of a technology, moving from market product to personal artefact). The Ruter Travelcard offers 24-hour, 7-day and 30-day tickets and a replacement for the earlier paper coupon card[22] and can be bought and filled up using cash or a credit card at service points, in certain kiosks, grocery stores, and so on. Travelers already in possession of a card can also fill these up at automats at stations/stops or online (if the card is registered with personal information and a credit card). In addition to a loading the Travelcard (with a ticket or money), the card needs to be validated at a reader before each travel. A new feature that users needed to adapt to in the early appropriation phase, was that the Travelcard could only be used by one person at a time.

***Objectification:*** (the positioning of a technology as a physical/visible artefact). Since the Travelcard is like a credit card, these are often kept together with other plastic cards (loyalty cards, payment cards, access cards, etc) in a *wallet* (the adults in our sample) – or a *pocket* (the teenager and student in our sample) like the old paper-ticket. Hence, the way users engage with the physical and visible artefact (the card with embedded RFID) is similar to other ways of handling and displaying plastic cards (and also similar to handling/keeping paper tickets) for access/transaction purposes. However, differently from a paper ticket (single travel) or the flexi-card (periodical paper ticket), the new contactless cards are not discarded after use. They are kept by the user as a permanent personal item. Hence, the contactless cards are both continuously present and visible to the users.

***Incorporation:*** (how the technology as artefact is incorporated into the everyday routines of users). In addition to being continuously present and visible to the users, the Travelcard is actively used and not rendered "invisible" for passive engagement only (as we saw with the AutoPass toll collection RFID-device). In order to travel with a valid Travelcard users need to ensure three things before they enter public transportation:1) that they have the Travelcard with them, 2) that it is filled up with money or a ticket, and 3) that it is properly validated at the reader before travelling.

The fact that Travelcards are small and can be kept in several places, and may be put irregularly to use, makes them more vulnerable to loss and integration into functional everyday practices. Our informants, especially the youth, had experienced not finding the cards when they needed them. As the information on the card is invisible, hidden in the technology, users needed to remember what they had done with the card previously. Information about ticket or balance could only be accessed by tapping the card at the automats. Then information was given briefly for a few seconds. They also needed to understand the signs they were given when validating the card at the reader

[22] They also offer a one-time magnet card ticket system (Impuls) not discussed here.

and/or know how to pay at the automat when the card was empty. These new processes needed time to get used to, and made incorporation complicated.

When the mother who travelled with her daughter took out their Travelcards from her purse to validate them at the station reader, the one for her daughter was empty and she had to go to the automat to refill it (taking her credit card and placing it in the automat with the Travelcard) before giving it to her daughter to validate, and then put it back into her purse so she could find it next time she needed it. The grandmother found the validation at the reader too quick and difficult to understand and did not like to use the automats. Her solution was to carry two coupon Travelcards and have them regularly filled up at service points. The absence of personnel at travel points also left the initial adoption and establishment of a new practice for the grandmother unsupported. She therefore adopted practices with the new technology similar to what she was used to with the old paper coupon ticket.

***Conversion:*** (the practical and/or symbolic display of a technology or related competence in the public realm). The public debates point to a degree of user resistance to the appropriation of the Travelcard (in particular in the initial phases after implementation) and that Travelcard users are more active in communicating about the Travelcard to in public than i.e. AutoPASS users (engaging in discussions and debates about shortcomings of the new system in the media, blogs and remaking/resisting norms associated with the technology). None of the users in the field-study had engaged in public debate about the Travelcard, neither did they make discursive connections between the Travelcard, their possession/non-possession of it and their individual status and social belonging. Although they did express some frustration and resistance to the difficulties it had introduced, the observations suggested that they tried to comply with the norms associated with the technology and ride with a valid ticket in practice.

This discussion points to variations in the domestication of RFID technologies relating to the degree of automation, visibility of function, and how well the technologies align with and/or simplify pre-established practices. Whereas AutoPASS appeared to render practices after appropriation less complicated, the Flexus/Ruter Travelcard seemed to complicate both the appropriation and incorporation processes. While the in-situ functionality of AutoPASS serves as an invisible, fully automated, time and concentration saving device for drivers, everyday practices seemed to become more complicated for users of the Travelcard, in particular in the early phases of adoption, since the RFID technology introduced uncertainty and new dependencies in comparison to the old technology[23].

**Ruter (re)assembling the social**

As previously mentioned the Ruter Travelcard belongs to the group of applications where RFID is a *central feature of the product* and assumed to represent a core value for the consumer. This analysis suggests this is not so in the case of Ruter Travelcard. The "theoretical" functions and affordances suggested by the "encoding" or design of the new ticketing system, appeared to not match well with the "practical" functioning or "decoding" of the use of the cards by (some of) its users (Hall 1980). Flexus/Ruter has only recently been implemented at full scale following a long period, establishing a track record as a parallel system. At the time of study, RFID was part of a system service/product where the user (in the Ruter Travelcard case) had no good non-RFID

[23] This is users engaging with the contactless smartcards, and not the later app-version of the ticket system.

alternative. Hence, users of the Travelcard had to accept the RFID application if they were to use the public transport, although to some it appeared less convenient to them (although the marketing of the new applications were signaling increased user convenience).

In understanding why the domestication of RFID applications was so challenging in this case, we need to acknowledge it as a high complexity system involving a wide user group in its early "life phases". This implies that the user inteface might be regarded as easier to use in a pilot setting, where designers and pilot users are familiar with the technology, and not constrained by everyday practices and contingencies. The actual users, on the other hand, need to change several ways of "doing" the technology compared to how this was done previously, fitting it into their everyday life. We consider this aspect further by attending to how the travelcard was implicated in 'assembling the social' in new ways.

The application of the *ANT perspective* involves detailed empirical studies of the *interplay between technology and subjects*, regarding the social as a product of such action, not as a precondition (Latour, 2005). The Ruter Travelcard reassembled the interactions between people and things. In comparison to the previous use of paper tickets – on which the ticket price and valid riding time was printed and which could be bought from a person (with competence and communicating skills) – the electronic ticket transformed travelling into an interaction with ticket automats, validators and travel cards with invisible information. A greater degree of complexity and difficulty for the users travel practices was introduced, where increased convenience was promised. The Ruter Travelcard moved much of the agency and responsibility to interact with the ticketing technology from the travel company service personnel to the individual users – a move where the technology was given more power in the translation and, simultaneously, the user less power. This power asymmetry would, considering the wide user base, be perceived very differently from one user group to another.

**Assessing functionalities from supplier and user perspectives**

In this section the functionalities and benefits envisioned and portrayed by the providers that implemented the Ruter Travelcard are compared with the hands-on experience of the technology/functions by users. The assumed advantages of RFID-enabled systems/services in general, as seen by suppliers/providers, are often increased automation, unique identification, improved visibility, real-time information, and enhanced information about products such as components/ingredients, improved efficiency, and reduced costs for asset tracking and management (Evans, 2004). Sometimes lower prices for consumers, higher product availability, faster check-out and more efficient product (and person) tracking are claimed as benefits as well (Slettemeås, 2009). However, such benefits need to be evaluated for each case. In addition, there may be differences in how the supplier and the user side of the technology perceives and operationalizes the assumed benefits. This may lead to a mismatch on several factors, and for the users frustration may arise as the marketed benefits are lacking, while the suppliers side may seem to find the same marketed benefits to be highly relevant and satisfactory.

A central aspect of this can be understood by considering how the introduction of RFID application harmonized with *prior user practices* and how the *technology was communicated to users*. In the case of Ruter, these gains were not apparent. The users of the

Ruter Travelcard are a much more diverse group (including children) and the technology is proximate to the body. This diversity in the user base increases the functional requirements for the technology and the potential vulnerability of the user. An additional problem for the implementation of the Ruter Travelcard was the potential function creep in addition to the original aim to enhance payment and payment control, which was sought by the suppliers from the very beginning (surveilling and mapping travel patterns, and combined/integrated services). In addition, it is crucial to identify actual *well-functioning user practices of the previous technology/service* (as not all technologies/services are replaced because users are dissatisfied).

It is noteworthy that although early Flexus/Ruter pilots included user trials, the results unfortunately did not yield information that would discourage or adjust these developments. This points to the importance of pilot trials that enable a *realistic investigation of user practicalities and concerns for a diverse group of users*. The framework presented in this case study suggests a conceptual framework and methodology for such future investigations.

# 6 Case 5: Oslo Marathon – running event

**Case study 5**
**Responsible researcher:** Jo Helle-Valle (SIFO)
**Time period:** 2012-2013

**Case study method**
The data collection was performed by Jo Helle-Valle. This includes two interviews with the sports club SK Vidar (in January and December 2012), in addition to internet search. The researcher has also tried the RFID-system himself through participation in Oslo Marathon on several occasions. In this way the researcher has practical experiences to draw from in the descriptive analysis.

**Introduction**
Oslo Marathon is among the largest sport events in Norway and is arranged by the athletes club SK Vidar. In addition to the full marathon and half-marathon, also shorter races are included, as well as special tracks for children. In 2011 more than 17.000 participants were registered. The RFID technology has been used in this race for a long time already and has become indispensable to the organizers. For one, the size and complexity of the event requires systems that can handle enormous quantities of data and information in a fast and reliable manner. Moreover, the participants' expectations about the user-friendliness is much higher now than only a few years ago. Today it is taken for granted that the runner will get instant lap times at passing points along the track, that photos are taken of the runners, etc.

**Technology and functions**
The RFID-system has been changed since it was first introduced in 1998, but the core functionality is that there is a tag attached to the runner and readers at given points along the racetrack; at the starting line, at regular intervals in the race, and at the finishing line. The readers report to a central computing system, which logs and processes all the different information. In addition to the time-taking at the actual race, the system is also integrated with functions such as photographing and identifying runners during the race, and linking different information about participants to various other systems – such as advertising.

The technology has been developed and changed in various ways during the time it has been in operation. Until 2011, the tag on the runner was a small device that was attached to one of the runner's shoes. A weakness in this was that the runner could forget to attach the tag or that it could fall off during the race. First the system was operated by the Norwegian firm *Emit* (which is large on sport events), but in 2006 the Danish firm named *Utility Service System* took over. Then, in 2012 *Mylna Sport*, a sports organiser from Løten in Eastern Norway was chosen as the partner on the field of technology and organising. With this change the RFID-tag was moved from the shoe to become embedded in the start number (on the runners torso).

The main reasons for the change to Mylna was, according the interviews, (i) that they were cheaper; (ii) that they were much more accessible in times of need (an hour's drive compared to getting people all the way from Denmark); and (iii) that they were better at linking the technological potential to commercial packages. Oslo Marathon has today a wide variety of offers

for workplaces, for clubs, local groups of participants, and so on. Furthermore, they have improved the organisation and packaging of transport, hotels and various leisure activities, in addition to the actual practicalities and transactions related directly to the race.

**Controversies and potential function creep**

As with a lot of other technology, the functionalities of RFID and embedded systems create new needs and opportunities – possibilities that were often not anticipated when the technology was first acquired. One function that has been developed in later years is linking the RFID-technology to other forms of digital aides. Among the most important ones are various aides for training. One device is to link your exercise to a program using Google Maps to visualise the race-track on a screen while you run on the treadmill. In this way, you both have a more exciting exercise and it gives you the opportunity to perform better at the race. Another function is to link your participation at the marathon to various social media; Facebook, SMS, Twitter, etc. Such hooks enable the participant to communicate with other racers, to get access to vital information and advice, and even get access to personal trainers. There are also services offered to the spectators; one can already get sms-based information on a given runner, which keeps the receiver informed about where the runner is at a certain time. Moreover, it will soon be possible to buy space at large boards for personal messaging. For instance, a runner's spouse can buy space on a board for a personalised message (e.g. "Come on Ola!") that pops up when the runner passes a board.

Many of these secondary functions are commercially motivated. With the opportunities that such new technology provide, there is a potential for so-called function creep. This implies that the technology (and the data that is harvested) is used for *other purposes* than first intended. In this case, so far, it seems that it is still used within the realm of the event; to improve the event itself, or to add commercial opportunities. It would be misleading to think of the arrangement as a cover-up for purely commercial interests. There are in fact some actors in the sport event sector that are purely commercial. For instance, a French company that arranges the Tour de France, is reportedly interested in gaining a foot-hold in the Norwegian sports arrangement market, and also American and Norwegian firms of this kind are operating in Norway. However, still most sports events are handled by sports clubs. *SK Vidar* is among the most merited athletes clubs in Norway and their stated goal with the Oslo Marathon arrangement is two-fold: 1) too contribute to a better, more healthy lifestyle among ordinary people (races of this kind motivate ordinary people to exercise regularly); and 2) to earn money for the club. The club's representative, interviewed for this case study, told that the whole profit from the arrangement was channelled into improved conditions for the athletes in the club.

**Privacy**

Another trait worth mentioning is that (according to the clubs representative) all commercial spin-offs from the marathon event are handled by the club. This is of course motivated by the wish to channel all profits back to the club (and thereby the local athletes), but also partly motivated by privacy concerns. *The Norwegian Data Protection Authority (Datatilsynet*) strictly regulates information databases like the one Oslo Marathon controls, and does not permit selling such databases to commercial third parties without explicit consent from those involved. The server where the database is stored is controlled by the company *Quicktime*, whose existence depends on following the Norwegian Data Protection Authority's rules and regulations. This aspect of letting third-parties access or use data collected for a specific purpose, is a general challenge to most companies/events that use more and more user data for developing services or commercial opportunities.

**Summing up**

To conclude; there is no turning back for sports arrangements like Oslo Marathon. They are wholly dependent on RFID-technology for performing the core functions and services demanded by users. The sheer size of the event is such that one needs technology that can gather

and analyse data on a large scale, on time, suited for both individual and event purposes. Moreover, all the spin-off functions that have been generated have somewhat "spoiled" the participants, so that other events that cannot offer services like the ones described above will have little chance of surviving in this highly competitive sector.

It seems that large sport events is a sector that is well suited for RFID-technology; the size, complexity and entertainment demands from the participants gives such technology a central role. It can be used to develop more integrated and interesting services based on and around the main event purpose. Moreover, the constantly increasing commercialisation of sports and exercise also suggest that this is a promising arena for developing further marketing or value-added services and functions. Hence, with RFID and sensors at the core, such events appear (as in the indoor waterpark case) as "mini-IoTs", where data harvested from user activities are analysed in real-time and developed into new services and functions.

# 7 Case 6: Coop ShopExpress – scan and pay for groceries

**Case study 6**
**Responsible researcher:** Ardis Storm-Mathisen (SIFO)
**Time period :** 2010-2013

**Case study method**
This case was followed over some time, beginning with desk/archive search in 2010 onwards, then talks/interviews with relevant stakeholders (due to competition aspects much of the interview material was not put in writing). Individual interviews were preferred to focus groups to get personal insights and to protect commercial information. A customer test of Shop Express (scan and pay on pilot) was performed in 2013.

**Introduction**
The scan and pay solution started on a conceptual level from 2007, and was presented to customers in Coop Express stores in 2011. By fall 2012 Coop introduced, to their member customers in the Coop Extra stores, a scan and pay solution based on a combination of mobile, phone/app solution and barcode scanning (first available on Iphone later on Android).

The discourse about implementing RFID-based systems in the distribution/supply chain and end services to consumers in grocery stores, has been addressed by actors in the Norwegian grocery market for several years. In the supply and distribution chain, several pilots have been conducted. Since 2007, RFID has been an implemented technology in the *Europapall* system used by COOP (and RIMI) distribution[24]. Hower, RFID implementation in the food chain system reaching inside the stores and all the way to the consumer and cash counter, still remains on the conceptual level (as of jan 2013). Rather than trying out RFID on the consumer end, trials with related technology, relying on NFC/wifi/barcode/app-based systems, seem to be preferred by many in the business sector – especially when it comes to the in-store end-services and at the cash-point.

Some stakeholders claim the reason is that business is stale and cowardy. Others say RFID-based technology and systems are too young and manifold and that it is too expensive, with too unclear business models, to motivate investments. There is a lot of uncertainty and worry about large investments that will fail on the one hand. On the other hand, there are ideas about future potential efficiency and big savings. The preference of implementing and trying out simpler AIDC[25] technologies in the grocery stores, rather than RFID technology, may act as preparations for RFID implementation in the future. But, this may also indicate that the RFID technology will be less relevant in the future.

**The case – technology and functions**
Since few actors had made concrete plans for, or implemented, RFID in the consumer end of the food chain by 2011, the first part of the case study focuses on the visions and scenarios of

[24] http://www.rfidjournal.com/articles/view?3829/. 17.11.14
[25] Automatic Identification and Data Capture technologies

the RFID technology by various actors in the Norwegian food chain system (decision makers within the food chains, experts/consultants, pilot practitioners, consumers). In the beginning, no particular food chains were chosen. The development was primarily followed through desk research – searching mass media news and postings on the internet. In 2012 the research centered on the grocery chain Coop. In the Norwegian context Coop seem to be the first to implement AIDC-technoloy in the end-service/consumer part of the grocery chain. They claimed to have been oriented towards this technology for several years (at least since 2007), and was by 2011 the most outspoken actor in terms of ambitions to implement RFID on the consumer end of the grocery chain. In 2011, Coop presented the Shop Express scanning device to customers in their Express stores.[26]

By fall 2012 Coop introduced, to their member customers (in the Coop Extra stores) a scan and pay solution based on a combination of mobile phone/app and barcode (first available on Iphone later on android). [New: In fall 2014, all coop stores offered ShopExpress to their customers[27].]. The scan and pay solution has been develop by Coop Handel themselves. Also, from november 2012 customers in Coop Extra stores could register a paycard on their user profile at coop.no and connect to the preferred grocery store.

In the retail sector more generally, there are several functions and services that have been considered when envisioning a future with RFID or similar technology, such as contactless payment, enhanced and on-time information about product, increased quality/security in terms of distribution/logistics/stock surveillance, improved anti-theft security system, tailored services and marketing/profiling of consumer/groups.

**User and societal aspects**

In terms of the tangible advantages to consumer of introducing this type of technological environment, the main benefits have been identified as time saving, as customers can scan their own items, and do not have to stop at the cash point. In addition, after purchase the receipt is saved automatically in the solution, hence there is no need to store paper receipts. On the negative side, the solution cannot be used to buy products that demands ID (beer, tobacco, adult material, etc), and hence staff must be called for. Also, the security of the personal phone (as a needed shopping device) is left to the consumer. For the stores, this solution means cost savings, as less manpower is need at the point of sale, and this could be freed to support customers in-store, or to fill up empty shelves. However, there are high initial costs of implementing the system. A report on tracking in the distribution chain[28] presents consumer/societal gains of such solutions as; potentially reducing unsafe food for consumers and increased safety/trust through a more transparent/efficient system; enhanced and on-time information about individual-level grocery products; enhanced information about niche products.

**Privacy and function-creep aspects**

Even with the potential for more automated systems, increased self-service, and enhanced information/marketing in retail, there are general concerns related to increased data harvesting from consumers, through more detailed profiles and tracking of customer habits. However, large grocery chains, sucha s Coop, already harvest large amounts of data from user profiles and purchasing habits through their loyalty cards. As of now, there are few trust breaches among Norwegian grocery chains in terms of misuse of customer data, or lack of secure systems. This has been more prominent in the US and in Germany, with novel RFID solutions among major supermarket chains in the mid-2000s (cf. Slettemeås 2009), which led to public outcry by consumer advocates.

[26] http://coop.no/PageFiles/14195/Coop_ShopExpress_folder.pdf
[27] http://innodesign.no/CAD-Teknologi/Ny-handlemaate-Skann-og-betal-med-mobil
https://coop.no/om-coop/samvirkelag/coop-hordaland-sa/aktuelt/shop-express/ 17.11.14
[28] E-sporingsprosjektets nyttevurderingsrapport (daVinci Consulting) http://www.regjeringen.no/upload/LMD/Vedlegg/Brosjyrer_veiledere_rapporter/Samfunnsoekonomisk_nytte_Sluttrapport_140309.pdf

# 8 Case 7: Slottsfjell – music festival contactless access/ payment

**Case study 7**
**Responsible researcher**: Dag Slettemeås (SIFO)
**Time period:** 2013 - Slottsfjell music festival (July 18-20, 2013)

**Case study method**
In this case study, the researcher conducted field work at the event and took active part through participant obeservation. Along with participating in the event and using the RFID technology services available, field notes and photos were taken. The researcher also initiated dialogue with other participants during/after the festival (short interviews), in addition to doing desk research prior to and after the festival.

**Introduction**
This case study is conducted to provide an example of how RFID is being employed in the leisure sector, more specifically at music festivals. For this purpose it was decided by the *RFID in Society* project on April 11, 2013, that a case study should be conducted, targeting one of the largest music festivals in Norway – Slottsfjell – to exemplify recent RFID introduction in the leisure/festival sector. Mass media and social media discourse has been followed prior to the 2013 festival to get an idea of how access and payment solutions have functioned, as a backdrop to the present festival access/payment solution. The ticket to the festival was purchased on April 12, and data gathering (online and paper) from mass and social media started. The festival ticket enabled the researcher to conduct comprehensive, on-site fieldwork (technology testing, observation, photo documentation and conversations with participants) during the entire festival period (July 18-20, 2013). In addition, interviews were conducted in the immediate aftermath of the festival with some festival goers. The fieldwork at the festival was also done to get hands-on experience with the festival and the functioning of the technology.

**Background and RFID potential for festivals**
It is claimed that more than 40 festivals worldwide have employed RFID technology so far – mostly embedded in wristbands – in order to offer fast-track entry, cashless payments and even social media integration. Furthermore, around 1.3 million festival-goers have used such wristbands, and it has been reported three million Facebook likes and a billion cashless transactions so far[29], a number which is rapidly increasing. In the case of the Ottawa Festival (Canada) the organisers claim that RFID will be a *game-changing* technology for live events[30].

RFID provides new functionality within three main areas for festivals; *access, payment* and *communication.* As an example of wide application of RFID, the Ottawa Festival is a good case at hand. The wristbands incorporate *personal profiles, ticket information, cashless payment*

[29] http://www.techradar.com/news/world-of-tech/rfid-wristbands-vs-nfc-smartphones-what-s-winning-the-contactless-battle--1167135 (retrieved July 29, 2013)
[30] http://www.ottawafestivals.ca/fr/interesting-fr/rfid-wristbands-changing-the-way-we-play-pay/ (retrieved July 29, 2013)

*system*, and *social media information*. RFID-enabled wristbands purportedly enhance access security as ticket information is stored on the chip, which is then embedded in securely fitted wristbands. Handheld readers scan the chips at the entrance portals, something which also imply *speeding up passage times* and *reducing or eliminating queues*.

In terms of payment, *credit may be transferred* to the wristband chips prior to entering the arena or at specific stations on the festival ground. This enables fast purchase of food, beverages and other merchandise. Personal data may also be registered through a website to personalize the wristbands, which enables *social media integration* and easier detection and action concerning *loss and theft*. Festival goers may also *check-in* to specific festival areas and update their status and whereabouts by linking personal Facebook and Twitter accounts to the wristband.

It is also claimed that counterfeit tickets and unwanted reselling of passes are eliminated[31]. Potential ticket fraud is not totally eradicated though, as print-at-home solutions and people posting photos of tickets (with visible bar codes) on Facebook, Instagram and Twitter, boasting about their attendance, is prevalent. Prior to the 2013 Slottsfjell festival, the organisers warned (through their own website and mass media) of the potential risk of publishing photos showing barcodes or number codes on tickets. Such pictures had been identified by the organisers on several occasions on Instagram[32].

**The Slottsfjell case**

The Slottsfjell festival[33], taking place in the city of Tønsberg, Norway, is one of the biggest music festivals in the country. It started in 2003 and has around 30 000 people attending the three-day event, which lasts from Thursday till Saturday every year (mid-July). During the first eight years of the festival, tickets were swapped for wristbands to be used only for access control, while a voucher system was used for purchasing beverages. Other merchandise had to be bought with cash or credit card. The first RFID system was introduced in 2012 while this was replaced by a new system in 2013.

Going back to the pre-RFID era; in this case access control required a larger work force in order to perform access control, as wristbands were checked manually. There was no ID attached and potential counterfeit wristbands could circulate. The wristbands had no other function than to prove that a festival attendee had purchased a ticket, either for individual days or for the whole event. When participants entered the festival area they needed to purchase vouchers that could be traded in for beer and other beverages. However, long lines of people wanting to purchase vouchers made this experience time-consuming. One blog[34] documents the 2008 festival and focuses on the long queues for both purchasing vouchers and for swapping these for beer.

**The 2012 RFID system**

On June 7, 2012, the festival website announced its new contactless payment system[35]. The site explained how the system worked; how to load the chip on the wristband with money and how to reload at several "loading stations". Furthermore, mobile loading equipment was carried around the festival area by festival workers. This first announcement promised more efficient purchases as well as the opportunity for getting refunds. Refunds had not been achievable with the previous voucher system. The post generated responses from previous and potential festival goers to the 2012 festival, and many were positive to the new chipped wristbands. This was

[31] http://www.ottawafestivals.ca/fr/interesting-fr/rfid-wristbands-changing-the-way-we-play-pay/ (retrieved July 29, 2013)
[32] http://www.vg.no/musikk/artikkel.php?artid=10103677 (retrieved May 30, 2013) and http://www.slottsfjell.no/2013/05/27/ikke-del-billettkodene-deres-pa-nettet/ (retrieved May 30, 2013)
[33] http://www.slottsfjell.no/
[34] http://www.raseri.nu/Templates/Kultur/2008/juli/slottsfjell_retrospekt.html (retrieved April 15, 2013)
[35] http://www.slottsfjell.no/2012/06/07/nytt-betalingssystem-pa-slottsfjell/ (retrieved April 15, 2013)

also reflected in comments from the organisers in news media just before the event[36]. They claimed much positive feedback from participants as well as a high number of people (60 to 70 percent) loading funds onto the chip while trading in tickets for RFID-wristbands.

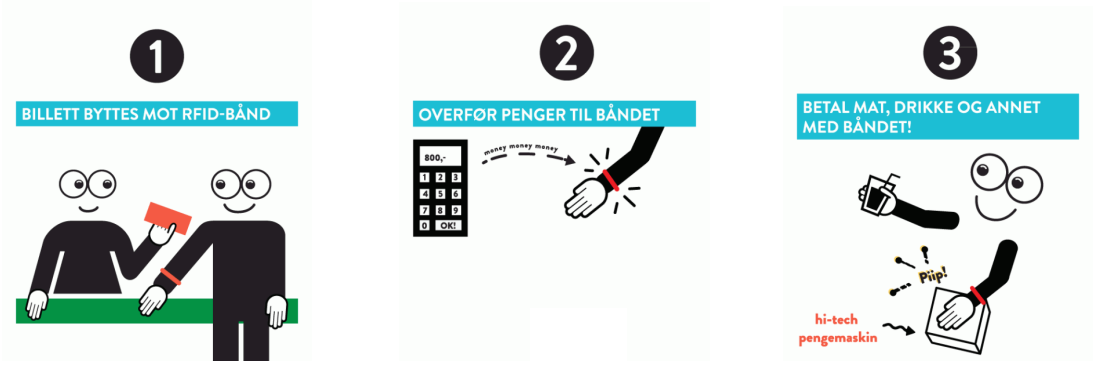


**Image 1 – Source: Slottsfjell.no**

Returning to the comments on the Slottsfjell webpage[37], several concerns about the new RFID-system were also raised. One participant voiced the potential inability for physically handicapped people to let others do purchases for them (they could no longer give vouchers to their friends), as well as the difficulty for people in wheelchairs to reach contactless terminals if these were fixed on the sales stations (the same problem may occur with loading stations). The organisers responded that this had not been considered, but that they would look into it. However, after the festival the same participant stated that he was not able make purchases himself as the food and beverage stations were too high for him. Another concern was potential cost increases due to the new system, which would potentially lead to higher expenses for festival participants. The organisers responded that no extra costs would be incurred; rather the contrary as more efficient purchases and shorter queues would benefit festival participants.

A third issue was security. Some were concerned that with no pin codes anyone could potentially swindle users, making the RFID system less secure than paying with credit cards. The organisers responded that wristbands are firmly fixed to the wrist, that the chips contain unique identifiers, making it possible to stop further use and also to transfer money to new chips. Sales stands cannot accept bands that are not fixed to the wrist, which is also a security mechanism. A fourth concern was data crash that would deny people to purchase beverages and other merchandise. The response to this was that the new system did not engender other technical challenges than previous systems (e.g. calling up and verifying card payments). Furthermore, the balance is *within* the chip, and also in the data system. In that way alternative solutions can be found if data crashes occur or internet lines go down. Alternatively, if chips get destroyed, the balance can be retrieved from the data system. A fifth concern was robustness, but the organisers claimed that wristbands can withstand water and other external damage. A sixth worry was the inability for one person to purchase beverages for several other people (the same concern as for handicapped people), which was claimed to be both inconvenient and could potentially increase queues. There were also complaints about too few stations for loading cash onto the chip, generating lines[38]. These concerns were not responded to directly, but in 2013 the number of loading stations was increased.

Immediately after the 2012 festival, people (using the same comment field) were concerned about lacking information about how to get their surplus money balance refunded. These concerns continued from July 22 until August 2, 2012 without any response form the organisers.

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[36] http://touch.tb.no/nyheter/na-kan-du-kjope-ol-til-slottsfjellfestivalen-1.7446631 (retrieved April 15, 2013)
[37] http://www.slottsfjell.no/2012/06/07/nytt-betalingssystem-pa-slottsfjell/ (retrieved April 15, 2013)
[38] http://tb.no/kultur/slik-far-du-pengene-tilbake-1.7455855 (retrieved July 30, 2013)

Such information was promised earlier, while users commented that the direct information links from the festival webpage did not work. On a dedicated Facebook festival link (retrieved April 12, 2013 – which later has been deleted) – many festival participants were confused as to how they would get refunds and how long time the refund process would take. On a Twitter feed[39], in late August 2012, people stated that they still hadn't been reimbursed, while festival organisers claimed most customers had been refunded but that data trouble had caused delays. In the aftermath of the festival these refund concerns and the ensuing confusion appeared to actually threaten the future use of the payment system.

**The 2013 RFID system**

As late as in April 2013 it was not clear what kind of system would be used for the 2013 festival, which was set for July 18-20. On the official festival Facebook site (www.facebook.com/slottsfjell), an announcement about expanding the festival showed a map of the festival area, indicating *loading stations* for RFID chips[40]. On another timeline figure, however, the map indicated *voucher stations* rather than chip-filling stations[41]. Users were confused, posting questions whether the chip solution had been abandoned and replaced by the old voucher system. Organisers responded that this (as of April 10, 2013) had not been fully decided.

At some later point, the festival webpage posted information about the payment system, indicating that a chip solution[42] would be continued. This information explains that the wristband chips are the only means of payment available inside the festival area. It also explicitly states that RFID-technology is embedded, and that up to 5000 NOK[43] can be added to the chip, making the wristband a valuable item that needs to be carefully handled.

It was also stated that physically disabled people now would get a card-based solution (answering to criticism about difficulties with reaching the POS[44] terminals with the wristbands). One user, being interviewed in the local newspaper, states that this is much easier as she can let others make purchases for her, while she can stay at the handicap spots[45].

**Intellitix and Intellipay**

The Slottsfjell webpage posted on July 13, 2013[46] that the new payment system for the 2013 festival was being supplied by Canadian *Intellitix*, but that is was partly based on the same system as in 2012 (which was provided by *ID&C*, a UK-based company providing full range services from design of wristbands to RFID functionality). On their official webpage[47], Intellitix boasts a range of services including RFID access control, cashless payment, social media, audience profiling, brand activation, mobile applications and staff management. The company also markets the potential for integrating these services: "Using RFID for access control also opens up endless possibilities for cashless payment, brand activation and social media integration". Intellitix further declares that the *Open Road Festival*, taking place in June 2013 with technology provided by Intellitix (Intellipay), was the world's first fully integrated RFID festival including access control, cashless payment, and social media. Stavernfestivalen (July 11-

[39] https://twitter.com/Slottsfjell/status/239021331402858497 (retrieved April 12, 2013)
[40] http://www.slottsfjell.no/2013/04/10/slottsfjell-blir-en-enda-storre-festival/ (retrieved April 15, 2013)
[41] https://www.facebook.com/photo.php?fbid=10151342524041752&set=a.383317036751.166604.28825986751&type=1&relevant_count=1&ref=nf (retrieved April 15, 2013)
[42] http://www.slottsfjell.no/betalingsbrikke/
[43] NOK = Norwegian kroner
[44] Point of Sale
[45] "Rullevennlig festival", Tønsbergs Blad, July 20, 2013 , p.17 (Kultur)
[46] http://www.slottsfjell.no/2013/07/13/slik-betaler-du-for-mat-og-drikke/ (retrieved July 30, 2013).
[47] http://www.intellitix.com/ (retrieved August 2, 2013)

13, 2013) and Slottsfjell (July 18-20, 2013) were next in line to use the Intellipay system[48]. The main benefits advocated were fast validations of access and payment, cutting queues, limiting ticket fraud, while social media tools supposedly create closer bonds between festival goers (and loyalty to the festival), and improve the festival experience in general.

**The fieldwork**

The first part of the fieldwork, after purchasing the full festival ticket on July 12, 2013, was to download the *festival app* to the smartphone. This was a new and improved version of the app and it was marketed in the local newspaper[49] (as it was developed in collaboration with the same newspaper) on June 6, 2013. It boasted *improved maps* (including augmented reality functionality), *Instagram integration*, and the possibility of *loading cash* onto the chip from the app. However, the app was only available for iPhone and Android phones, something which irritated one respondent (male, 40) who possessed an HTC phone with Windows operating system. He clearly stated his discontent with this, as the app would have provided him with a full list of all concerts, and also a "my list" of favourite bands. Apart from the newspaper article, however, there was little information (e.g. from the festival website) on how to "learn" and get the full value of all these new functions.

The next phase of the fieldwork was to get hold of the wristband by standing in line at the city centre. This was done on the first festival day, July 18, 2013. The print-at-home ticket was scanned by the personnel, but it did not clear. The barcode numbers then had to be manually typed in, and the researcher finally got the wristband with the chip. It was securely fixed to the wrist and the researcher was then directed to a new station for loading up the chip with money. There was no line and the woman processed the transaction rapidly. The chip was placed at the terminal, the correct amount was paid with a debit card, the chip placed on the terminal again, and the money was "transferred" to the chip. This filling procedure took less than a minute.

After this the field work was a fairly continuous process, attending the festival for three days, entering and exiting, making observations, talking to festival goers, taking photos, writing notes, and testing the access/exit and payment system (in addition to adding new funds from filling stations, and attempting to use the app for the same purpose). These data will be categorised below in the six sections: 1) access, 2) payment, 3) social media linkage, 4) privacy/security issues, 5) refund/chip disposal opportunities, and 6) general impressions. Before attending the festival, it was noted that attendees could register their wristbands online, using the band-ID and a series number printed on the back of the plastic covered chip. This would link the individual wristbands directly to an identifiable person, making the identification of lost bands easier, as well as transferring balance if lost/stole/damages wristbands/chips occurred. This opportunity was however not mentioned by the festival staff when the wristband was distributed. Hence, the researcher did not register the wristband before after the festival was over, as this was needed to get excess credit refunded.

1) Access

The first experience with the RFID wristband was accessing the festival area on day one. There was no line near the entrance portals and the validation took only a second, putting the wristband near the validation box. There were only three entrance portals and validation points but no queues were spotted on either of the entry occasions. Security only observed people passing through the portals, and they appeared to listen to the correct validation sound – a bip. For the purpose of easing this job, each portal had a different signal frequency in order to avoid confusion.

[48] http://www.mynewsdesk.com/pressroom/intellitix/pressrelease/view/intellipay-cashless-payment-system-debuts-in-europe-889002 (retrieved July 30, 2013)

[49] http://tb.no/kultur/slottsfjellappen-er-klar-1.7923105 (retrieved June 6, 2013)

**Image 2: A typical Intellitix entrance portal from another event[50]**

When exiting the festival grounds on a mid-day occasion, we experienced compulsory check out by validating the chip on the way out, while this was not necessary at the late night exits (when massive amounts of people where exiting at the same time). This raised the question of what the purpose was for the initial exit validation. The value of such data would be to predict potential key periods of queuing, or to get individual data on entry and exit to get a richer picture of festival goers. This latter point is however problematic in privacy terms, and it would require a statement from festival goers that personal data would be gathered and used for value-added services.

2) Payment

The RFID solution allows for festival goers to load funds onto their wristband in advance, enabling cash-less or credit card-less purchase transactions. Or, one can load new funds at the event bringing credit cards or cash, but still reduce the number of transactions and avoid any transactions at the POS stations. Time use and queues are potentially reduced as there is no waiting for credit card transactions to go through. Fraud is also avoided as people cannot watch over one's shoulder to see the pin codes and later steal the credit/debit card. The wristbands themselves might be lost or stolen, but they are securely attached to the wrist, and event goers may register the chip on the wristband beforehand (as described earlier).

During the festival, the researcher purchased beverages, food, refreshments and other merchandise. The first transaction was observed as one accompanying participant (male, 40) purchased a beverage. He made the order, was asked to place the chip at the POS screen, and then the cost of purchase was displayed. He was told to place the chip on the screen once again to confirm the purchase, and the balance was then displayed. The operation (from ordering to receiving the beverage) took approximately 15 seconds.

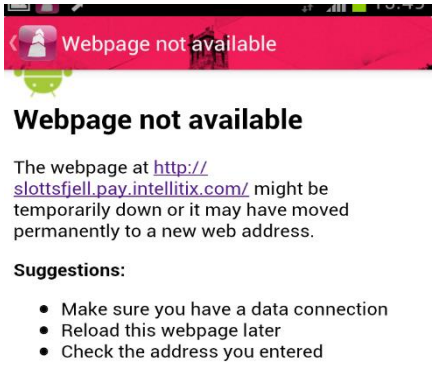
[50] Source: http://www.alancross.ca/a-journal-of-musical-things/2011/12/20/is-intellitix-the-end-of-scalping-and-ticket-fraud.html

**Image 3: Festival wristband (photo: SIFO)**

**Image 4: A user verifying purchase (photo: SIFO)**

The other purchases were fairly similar; short lines, fast orders and quick transactions. The convenience of not having to bring a wallet was noticeable, although the credit card was still in the pocket as the chip might have to be refilled. When observing the area and the different sales stations there were few signs of queuing and frustration. Only at the late events, in front of some of the beverage stations, there were tendencies of more or less queuing[51], but it seemed to result from badly organised lines rather than slow transactions. At the three stations where chips could be re-filled there was no sign of queuing, something which was a problem at the 2012 festival when there were fewer filling stations. To test the festival app, attempts were made on several occasions to refill the chip through the app function. Every time an error indication was displayed, telling the researcher that the system was down or unable to connect. Refilling was attempted all three days without success.


**Screenshot 1: Slottsfjell app**




**Screenshot 2: Slottsfjell app**

The app function was of course not critical for the experience as the three filling stations were easily available. Still, if the researcher had wanted to fill the chip prior to entering the festival area in order to leave the credit card at home, this would have caused frustration.

[51] Also confirmed in social media and in post-festival news articles, e.g.: "- Innsatsen er til å bli rørt av", Tønsbergs Blad, July 24, 2013 p.2 (Kultur)

Around the festival area service personnel were visible wearing black t-shirts with big RFID logos on the back. They appeared to be security guards at first glance, with their uniformed look and walkie-talkies, but they were apparently moving around the festival area to support sales stations. They could potentially also be carrying hand-held scanners to verify authentic wristbands, and in that sense have a security function. But this was not inquired into.



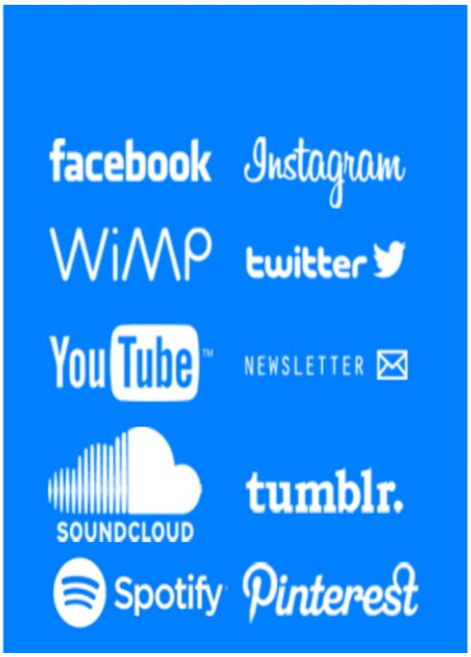
**Image 6 & 7: RFID personell at sales station and on festival ground (photos: SIFO)**

As "RFID" was visible on the back with large letters, it appeared that they were approachable for festival attendees, but presumably the term RFID is not recognized by most people. One festival attendee (female, 35) in an interview vaguely remembered to have seen these men, saying they looked "important" wearing black shirts and lots of electronic equipment. She had not noticed the letters on the back, and when informed by the researcher that it read "RFID", she stated that this was not a term she was familiar with or that she linked to the access/payment technology. RFID is mentioned once on the festival website when explaining the payment chip[52], but the term is not generally marketed by the festival to educate people. This differs from the strategy of e.g. the Ottawa Festivals in Canada[53] where RFID is explicitly used as a means of exciting and engaging event goers. They even write articles on the technology to inform participants of what this technology can do and how it may change the festival experience.

### 3) Social media

The Slottsfjell festival appears to pride itself on its social media presence. The festival is active and has profiles on several social media sites, such as Instagram, Twitter, Facebook, Youtube, etc. – and feeds from the first three are actively promoted and updated on the festival webpage. The 2013 version of the app provides Instagram integration, making it easier for festival goers to share their experiences through smartphone photos.

[52] http://www.slottsfjell.no/betalingsbrikke/
[53] http://www.ottawafestivals.ca/fr/interesting-fr/rfid-wristbands-changing-the-way-we-play-pay/ (retrieved July 29, 2013)




**Screenshot 3: Slottsfjell app (SIFO)**


**Screenshot 4: Slottsfjell app (SIFO)**

Using online and social media – and being generelaly present on many "digital arenas" – may generate expectations by festival goers of swift responses from the organisers when issues are addressed. Conversely, lack of response may generate dissatisfaction. A quick glance at e.g. Facebook, Twitter and the festival webpage shows that many questions posed by interested people are left unanswered. There are also different people answering on behalf of the festival (being affiliated, but using their private profiles), something that may generate confusion or distrust as to what responses represent the "official" opinion.

According to the CIO of Intellitix (providing the RFID technology for Slottsfjell), some 30,000 attendees registered their wristbands online and linked these to their Facebook profiles[54] at the 2012 *Coachella festival* (USA). Furthermore, at the *Bonnaroo festival* (USA) the wristbands can be linked to Facebook enabling social media functionality while also giving access to merchandise discounts, set lists and free music from Bonnaroo bands[55]. At the same festival the RFID wristbands helped generate 1.9 million Facebook likes[56].

It appears that Slottsjell, although not promoting a full integration strategy (partly or fully integrating RFID, NFC, social media, apps, online, etc) as seen with various other festivals, it is still moving in that direction. In a local newspaper article[57] after the 2013 festival it is stated that at the next festival, the wristband would be more ecompassing, containing more information, functionality, social media linkeage, and that it would be active both on the festival ground as well as on the clubs in the city area.

4) Privacy, security and robustness

[54] http://www.ibtimes.com/rfid-wristband-about-latest-music-festival-technology-bonnaroo-bamboozle-coachella-more-705702 (retrieved July 29, 2013)
[55] http://www.ibtimes.com/rfid-wristband-about-latest-music-festival-technology-bonnaroo-bamboozle-coachella-more-705702 (retrieved July 29, 2013)
[56] http://www.techradar.com/news/world-of-tech/rfid-wristbands-vs-nfc-smartphones-what-s-winning-the-contactless-battle--1167135 (retrieved July 29, 2013)
[57] "- Innsatsen er til å bli rørt av", Tønsbergs Blad, July 24, 2013 p.2 (Kultur)

When the researcher received the wristband and loaded the chip with "cash", details about the chip and purchases were inquired. The woman, apparently trying to keep up the pace of filling up chips, gave a small information card that provided further information about how to use the chip, why and how to register the wristband, how to make purchases, and how to get a refund. This information card was very useful, as verbal information would easily have been forgotten. However, it seemed that people needed to be "active" to get it and most people probably lost or forgot about the piece of paper. There was also a second paper card (of higher paper quality) containing the event program and a map of the festval area. The initial thoughs of the researcher was that this information should be in one piece, preferably laminated, to make it appear of high importance to festival attendees. Or it could have been made available through the festival app.

One of the festival participants (woman, 35) explained in the post-festival interview that she did not get this paper-based information, and hence she was not aware of the refund opportunities, although she had money left on the chip. She had lost track of the wristband after the festival (lost or thrown away). She stated that this type of information should have been more explicitly marketed. Apart from this information deficit, she felt completely safe moving around with credit on her wrist. Even though she had filled the wristband with a larger sum of money, the wristband was properly fixed. If she had known about the refund opportunity she would have considered charging the chip with a higher amount to avoid several refillings. However, she realised that it was unavoidable to bring the credit card with her as she, after the festival, went out toareas that do not accept the chip.

The chips and wristbands were fairly robust. The three-day wristbands were made of vinyl, while the single-day bands were made of plastic. Daily showers, or regular hand wash, did not cause any damage to the wristbands during the festival period. This is line with what the CIO of Intellitix comments; that the wristbands are fairly indestructible[58] and that the cover protects it from dirt and water, enabling festival goers to wash hands and shower with the wristbands for an extended period of time. This is a further advantage compared with credit cards – and coupons – that are less robust. Paper coupons, in particular, are vulnerable to water damage and coan be counterfeited or easily lost or stolen.

The notion of privacy was difficult to assess. The researcher did not register a profile at the beginning of the festival, which would have made him identifiable with the chip (the chip contained a security number and a wristband number). The purpose of this link, other than for security reasons as stated in the beginning, is not clear. It could be that it would enable further value-added services, but this seemed not to be a priority. It was however surprising, as stated earlier, when on one occasion the wristband needed to be validated when exiting. As seen in the cases of the public transportation case, it can prove challenging in privacy terms to gather too much locational data about users (at least when information is not provided about the intention of this), as it makes it easier to track these.

Privacy and security concerns, in the case of festival chips, may relate to purchasing data (shopping habits/preferences), personal profile data (being transferred to third parties for tailored marketing), real-time tracking of the whereabouts of festival attendees, hacking of chip data, etc. To check what information could be retrieved from the wristband chip, the researcher used the *NFC TagInfo* app, developed by the research facility *NFC Lab Hagenberg*, available for free in Android Market. By activating the app and tapping the chip I got a whole range of data, including the full chip ID number (but not the security code), the type of RF technology being used, tag type, manufacturer, memory size, etc. Whether these data could be misused (by scanning someone's tag with their NFC-enabled smartphone) is not clear. Most likely all sensitive

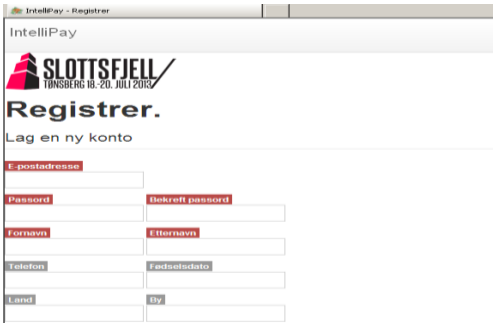
[58] http://www.ibtimes.com/rfid-wristband-about-latest-music-festival-technology-bonnaroo-bamboozle-coachella-more-705702 (retrieved July 29, 2013)

data are encrypted and the proximity required for being able to activate an RFID transmission limits any potential large scale attempts at compromising data.

5) Refunds and chip disposal

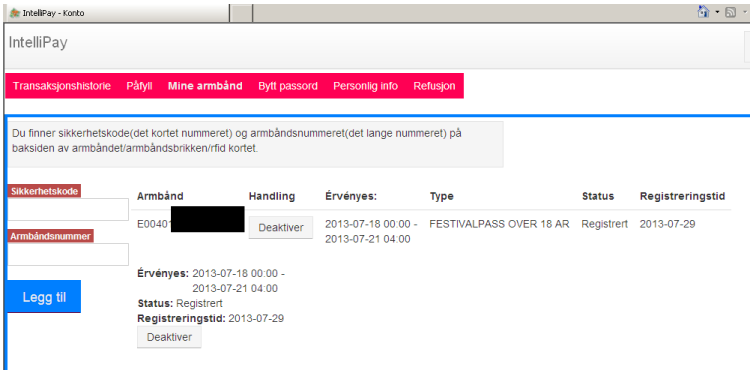
The wristband was registered after the festival was over – on July 29, 2013 – in order to get surplus credit refunded. All purchases and times of purchase were listed, as well as the balance. When registering for refund, the webpage had moved the "Chip refund" function and made it highly visible (screenshot 1). Then a simple registration form had to be filled out with email, password, full name and some voluntary information (screenshot 2). Then the short security code and the wristband ID number (both on the back of the laminated chip) had to be entered before the profile (screenshot 3) and the transaction history (screenshot 4) were displayed. Clicking the refund icon (screenshot 5) provided the option of donating the surplus credit to charity or the get a refund. Refund was in this case chosen to test the function and how much time the refund process would take. The 2012 festival received negative media coverage due to the problems they encountered when trying to refund people. In this case the refund was transferred to the bank account on August 6, 2013, only 8 days after the form was registered. It was notified in the local newspaper[59] on August 8, 2013 that the deadline for claiming refunds was set to August 11, which is a very short time after the end of the festival. This was justified through claims of security demands by payment card operators.


**Screenshot 5**

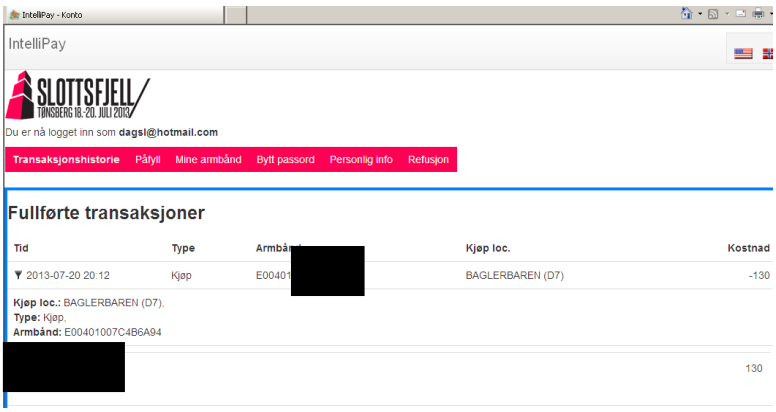



**Screenshot 6**

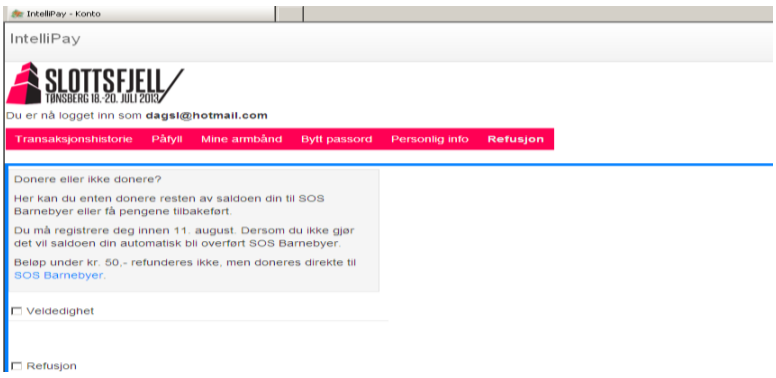
[59] Tønsbergs Blad, 6. august 2013: "Har du penger igjen på chipen?", s. 9




**Screenshot 7**




**Screenshot 8**




**Screenshot 9**

The refund opportunity make people take care of the wristbands for some time after the event is over. Hence they bring the RFID chips home. However, most people lose or throw away the wristbands and the chips. There is still no opportunity to save or collect the bands for future use. If all festivals, and other events, were to use RFID, there would be millions of electronic chips being wasted after only brief use, and most of these are probably thrown in the garbaga bin. In terms of the Slottsfjell festival, there was no information on the festival site of how to discard of the chips properly, either as a security measure or for environmental concerns. With deeper profiling and more functions related to the wristband chip in future events, it seems natural that the "afterlife" of the festival chip is taken into consideration.

6) General perceptions and comparisons

The festival participants that were interviewed were generally very satisfied with the 2013 festival and the technology being used for access and purchases. There were some frustration concerning the beverage sales stations, but this could be attributed to too few stations and badly organised lines rather than inefficient technology. As a participating observer the researcher was impressed with the speed of the system – both the transaction time and the total purchase time. The speed of accessing the festival ground was equally impressive, and there were no technical errors encountered (apart from the refill function of the festival app).

One participant (male, 34) claimed that the transaction system almost went too fast. He experienced that his balance got drastically reduced after every purchase, but he did not have time to verify the previous balance, the incurred costs, and the new balance (and no receipts were given). Hence the system worked almost too efficiently, while the balance show non the screen (at the POS) was swiftly removed to make room for the next customer in line. The participant was not concerned that he was being overcharged, he just lost track of the costs as he did not see his balance after each purchase.

Another participant (female, 35) had extensive experience with festivals and had tested other app-based solutions. She thought the Slottsfjell technology worked slightly better than an alternative app-solution she had tried[60]. This app only worked for purchases while a traditional wristband was needed to get access. The app could be used at several festivals by the same organiser, and could be activated via a login function. Then specified items (not a credit amount) could be placed in the online basket and purchased with a credit card. At the event, when the order was taken, a QR-code was generated by the app on her smartphone and scanned by the sales personnel, automatically deducting the number of items purchased. A receipt of the purchase(s) was then sent to an email account. The downside of the app-solution was the dependency on good battery capacity of the smartphone, which she did not have. Flat battery would hamper access validation and purchase. The battery issue is not relevant to the RFID chip as it is «passive» and powered by the reader at the POS-terminal.

**Conclusion**

This case study has looked into how a large music festival integrates the latest RFID technology to produce a more efficient and enjoyable festival experience. The RFID wristband makes all access and purchase validations intuitive as the wristband chip can be "tapped" at POS terminals. Thus, the festival goers do not have to swap between wristbands (without chip), coupons, credit cards, etc. This potentially augments the experience for the festival goers, both in terms of simplifying access and purchase situations, as well as reducing queues and intensifying the social aspect through social media sharing of photos, videos and text. RFID also generates increased sales for organisers as transaction and total purchase times are reduced. The Slottsfjell organisers commented in a local news paper article[61] right after the 2013 festival that next year's wristband would be "freshed up", containing more valuable information and functions and further social media integration. It would also be applicable outside the festival area for downtown event-related clubs and events.

On their webpage, *Intellitix* (the RFID solution provider for the Slottsfjell festival), promotes several scenarios for integrating RFID technology with social media and user profiles. For social media they propose[62]:

> *"The opportunities that social media present to an event environment are quite literally immense. By linking social media profiles to an event-goer's RFID device, you and your brand partners are promoted extensively to the wider digital world, with each interaction proven to result in up to 1,000 page impressions online. By connecting*

[60] The Tikkio app from Eventify, downloaded from App Store to her iPhone.
[61] "Innsatsen er til å bli rørt av", Tønsbergs Blad, 24. juli 2013, s. 2 (Kultur).
[62] http://www.intellitix.com/services/socialmedia/ (retrieved Nov. 14, 2013)

> *friends through social media, audience members can interact across the site, while engagement points allow them to share their experience online. Possibilities include check-in points, status updates, static photo booths and roaming photographer's with RFI enabled cameras, competition zones, content download, playlist construction and digital reward areas. Meanwhile, custom-built measurement dashboards allow you to gauge how far that excitement has spread beyond your gates."*

In terms of user or audience profiling they state[63]:

> *"Intellitix allows you to know more about your customer. Much, much more. The event environment need no longer be a place for guestimates or unknowns, but rather a space that can be tailored to suit individual preferences and likes. Our audience profiling tools allow organizers and brand partners alike to gain revolutionary insight into event-goers, enhancing the experience for all. Imagine knowing who every member of your audience is, where they're from, who likes a particular band or theme park ride, who prefers beer over wine, who prefers Twitter to Facebook, who left early... the possibilities are as endless as the benefits: Refined marketing campaigns, loyalty discounts, personalized offers or incentives, or just simply knowing how best to communicate and when".*

These scenarios and intentions show that there is a huge potential for using the RFID/NFC technology in the festival sector, and for integrating RFID with other technologies, systems and social media opportunities. The challenge is to properly integrate all functions and to create meaningful solutions for festival goers. In addition, there is a huge potential for data harvesting and transfer and it is critical that the users are informed about what data are being gathered, for what purpose, and how these data are being stored, shared and transformed into value-added services and augmented experiences.

[63] http://www.intellitix.com/services/audienceprofiling/ (retrieved Nov. 14, 2013)

# 9 Case 8: Trondheim clothing stores – item-level RFID

**Case study 8**
**Responsible researcher**: Stefanie Reinert Jenssen (Post Doc, TIK-UiO)
**Time period:** 2012-2013

**Case study method**
In this case study all data were collected by Jenssen and is part of the post doc work done in the *RFID in Society* project. An interview was conducted with Kris Doane, formerly *American Apparel*, USA, now CEO at Arden Data, RFID Solutions Architect, September 2012. In addition, there were dialogues with apparel industry, service providers and technology partners at the Nordic ID event "Experience Fashion RFID", Paris, June 2012; dialogues with shop assistants at *American Apparel*, Paris, June 2012; telephone interviews with *Gerry Weber, Scandinav ia* and fieldwork at *Gerry Weber,* CCVest, Lilleaker (contact Miriam Hovden, shop manager) and *Gerry Weber*, Glassmagasinet, Oslo (contact shop assistants), and finally unstructured dialogues conducted with shop assistants in various Oslo, Paris, Berlin and New York retail warehouses and fashion shops (2012-2013). Furthermore an online-based literature review was conducted.

**Background and motiavtions for RFID-implementation in fashion retail**
The introduction of RFID in the retail industry has been based on the idea that implementing RFID can *lower operational costs* and *minimize theft*. RFID is implemented to enable *higher inventory accuracy*, *faster restocking* and *faster action* in case of missing and misplaced articles. When RFID is integrated with Enterprise Resource Planning (ERP) [64], information about warehouse stocks are improved.

*Stock movement through RFID gates can be tracked*, such as shop entrances, floors between stock and shop rooms. In the sales shop, shop assistants can take stock of garments and accessories fast and more frequently with the help of RFID handhelds. Every article can be *located quickly* and this leads to more sales. Once the product has been registered as sold at the point of sale (POS), RFID enables *immediate stock correction*. RFID has also reportedly improved sales through *faster sales services* to existing customers and attracting new customers by *enhancing the entertainment value* of shopping, so far through optimal shop layout and modelling garment presentations to shoppers' taste.

**Industry diffusion of RFID technology**
RFID has been in use since the late 1960s, so the various uses of this technology and its potential benefits have been argued for and explored for decades. The apparel industry became interested in its possibilities for changing business processes between 2006 and 2009. In the USA, the Voluntary Interindustry Commerce Solutions Association (VICS) – founded in 1986, and today one of the most influential organisations for standardisation of cooperation together with standards groups GS1 US and GS1 Canada, announced the launch of the "Item Level RFID Initiative" in 2010.

[64] http://en.wikipedia.org/wiki/Enterprise_resource_planning

This initiative brought together apparel manufacturers and retailers—including Conair, Dillard's, JCPenney, Jockey, Jones Apparel, Levi Straus, Macy's, VF Corp. and Wal-Mart—to develop a *roadmap for the adoption of RFID* at the item level. In June 2010, the VICS Board announced its support of electronic product code (EPC) standards for the Item-Level RFID Initiative. All these standardisation efforts have led to a standardisation merger between GS1 US, VICS, and the Apparel and General Merchandise Initiative for the development of standards, guidelines, and best practices for RFID in the apparel industry in 2013 (VILRI). One of the earliest adopters of RFID in the US fashion industry is *American Apparel Inc*., which reported in February 2012 that it intended to equip all of its 280 global stores with RFID.

In Germany, fashion company *Gerry Weber* (GW) initiated the implementation of RFID for its entire supply chain in 2009. RFID was deployed not only to optimise the processes of logistics and retail, but also to function as a *new form of electronic article surveillance*. In *Gerry Weber's* implementation process, the ordinary care label was enhanced to a textile RFID label that combines electronic article surveillance, manufacturer care specifications and the electronic product code (EPC). Since January 2011, GW has equipped more than 26 million of annually produced articles of clothing with RFID technology, elevating the *Gerry Weber* Company to a pioneer in the field of RFID technology in German and European retail.

In Norway, the adoption of RFID technology in fashion retail is rather slow, often attributed to the relative small size of fashion companies with Norwegian or Scandinavian owners. In Trondheim, the fashion store *Bogart* has implemented RFID in its supply chain and sales store activities. *Gerry Weber*, Trondheim, Norway, has so far not shown any interest in integrating RFID tags with business processes. Here too, the general argument is the relatively small size of GW shops in Norway. However, there are differences even on local levels. Whereas GW at CCVest in Oslo, Lilleaker, does not have a strategy for future utilisization of RFID tags already embedded in its retail ware, GW at Glassmagasinet in Oslo has been reported to consider utilising RFID integration due to expanding shop floor size (source: interviews with service providers at GW, Oslo).

Considering the potential of RFID for after-sale activities, innovative Norwegian fashion retailers might be expected to start discussing RFID implementation with technical and standardisation actors in the field within 2013. After sales activities based on RFID are emerging in the vehicle industry, mostly focused on maintenances and repair. Within fashion, some small international projects regarding innovative after-sales activities with RFID have started to connect fashion to music, arts and design industries. An unplowed research field is the future of closed loops in apparel. Apparel companies like *Marks & Spencer*, Great Britain (M&S, GB) have started working towards the goal of a closed-loop system with the launch of its 'Shwopping' initiative in April of 2012. The scheme encourages shoppers to donate an old item of clothing every time they buy a new one. Clothes are then either donated to Oxfam to be resold or stripped back to fibres and remade. M&S expects RFID to play an increasingly important role in the *clothing recycling process* as it moves towards a closed-loop garment supply chain.

**Privacy concerns**

Due to its increasing diffusion in apparel industry the benefits arising through RFID tagging have met customer resistance and fear of loss of privacy. Three approaches are meant to address consumer privacy concerns. One is to disable RFID tags at store exits. The second is to lock tags and have users unlock them if they want to initiate reader communication (user model). The third is to let the network access users' RFID tags while adhering to a privacy protocol (network model). The reactions of future users to these three privacy-enhancing technologies (PETs), have been presented by recent research on RFID in the apparel industry.

The main conclusion is that *users do not trust complex PETs* as they are envisioned today. Instead, they prefer to kill RFID chips at store exits even if they appreciate after sales services.

Spiekermann (2007) identified six major concerns: 1) sense of ownership (this is my property, I want full control over my belongings), 2) fear of being tracked constantly outside stores, 3) fear of being responsible for objects due to individual attribution of unique products to people (being the buyer of a clothing item and thus responsible for its lifecycle), technological paternalism (the idea that objects recognize and punish misbehaviour: your phone telling you that this dress is outside your budget range), fear of information collection and personalisation (being classified as "low budget" inside a store and a neighbour seeing that one is only offered cheap stuff – "they know all about me and I know nothing about them"), and 6) fear of abuse in negative situations, such as spying.

As for now, it seems that apparel customers unanimously call for RFID tags to be killed at retailer exits. The same critique was met in focus group interviews by Auto-ID centres in the US, UK, France and Japan.

**Summing up**

Item-level RFID provides a key missing ingredient to in-store intelligence. When used with complementary technologies such as barcode scanning and payment terminals, it enables improved efficiency and decision-making. Using the collective information from these systems allows for improvements in many key retail operations that create efficiency and improve margins. Recent data show that item-level RFID deployments can increase sales between 4 and 20 percent (Motorola 2012).

Customers so far are adamant in their view on ending the lifecycle of RFID tags after sales, even when their attention is drawn to more efficient customer services in case of returns and complaints. Customers might enjoy new enhanced in-store services based on RFID, but seem to be concerned about "bringing RFID home". Innovation in the field of multi-functional RFID chips to enhance shopping experience is therefore still limited to shop facilities. Further research has to be done on the consumer perspective, on innovative as well as sustainable uses of RFID technology in apparel, and on further integration of closed-loop use of RFID to an expanded sense of Internet of things.

# 10 Case 9: Caring technologies – tracking devices

**Case study 9**
**Responsible researcher:** Anina Sætre Bjørnhaug (MA student, TIK-UiO)
**Time period :** 2011-2012

**Case study method**
The data for this case study was collected by Anina Sætre Bjørnhaug as part of her MA thesis work at the TIK[65] (which was tied to the *RFID in Society* project). The fieldwork commenced in spring 2011 and was finalised in May 2012. This study is of a theoretical character, looking at tracking technology (GPS, RFID) as an example of how technology is converted (or «translated») from its original purpose(s)/design(s) to a new purpose (tracking people in the caring sector), hence becoming part of the «caring technology» umbrella.

**Background**
How is actually a technology transferred and «translated» from one area of use to another? This is a highly relevant issue for the Norwegian health and caring sector today. Several official Norwegian reports, white papers and comments by political actors in the public arena, present a future where Norway will be facing vast demographic challenges. An increasing number of elderly, new user groups, and scarcity of health and caring personnel, is expected. (St. meld nr. 25 8, 2005-2006] i Innovasjon i omsorg, 2011: 9)[66]. To be able to provide satsifactory care in the coming years, the *Norwegian Board of Technology* (*Teknologirådet*), in the report *Fremtidens alderdom og ny teknologi* (2009)[67] underline that it is critical to create and embrace change. The question is; how can Norway deal with such challenges – and what changes need to be addressed?

Central actors argue that we need to think anew in terms of how care is «done» (*Innovasjon i omsorg*, 2011). It is in light of this perspective that the link between technology and care is put forth as a possible solution. In the official report *Innovasjon i omsorg (innovation in the caring sector)* from (2011: 98), it is argued that there is considerable untapped potential in this field. The caring sector – as other sectors – need to improve the quality of their services by using technology. This implies already existing technology as well as developing new assistive technologies and solutions in cooperation with commercial actors and research facilities.

The technology discussed here is in public discourse referred to as «welfare and caring technology». This technology is defined in the above-mentioned offcial report as technological assistance, which contributes to increased safety, security, social participation, mobility and physical and cultural activity. It should empower individuals to be independent in everyday life, regardless of reduced social, psychological or physical capabilities. Welfare technology (assistive technology) should also function as technological support for dependents and otherwise contribute to improved accessibilty, resource maximization and service quality. Welfare

[65] TIK – Centre for Technology, Innovation and Culture, at the University of Oslo
[66] Cf: https://www.regjeringen.no/contentassets/5fd24706b4474177bec0938582e3964a/no/pdfs/nou201120110011000dddpdfs.pdf
[67] Cf: https://teknologiradet.no/wp-content/uploads/sites/19/2013/08/Rapport-Fremtidens-alderdom-og-ny-teknologi.pdf

technological solutions should, in many cases, prevent the need for public services or admission to caring institutions (Innovasjon i omsorg, 2011: 99).

Tracking technology is one of several technical solutions that different actors have looked at in terms of finding opportunities and solutions for caring services. Such tracking enables localisation of people that are lost, and it is argued that it will be particularily suited for dementia care. In this case study (which is part of a larger work for the MA thesis), the researcher explores how technology, which was designed for other purposes, can be converted into caring technology.

**Theoretical perspective**

One of the main academic disciplines that study the relationship between technology and care is *STS (Science, Technology and Society*). Within this discipline, the study described here has been inspired by Hilde Thygesens (2009) study of smarthome technology, Ingunn Mosers (2003) study of traffic injuries, Jeannette Pols' (2010) study of *Telecare* and Irene Olaussens (2010) study of hearing impairment. All these texts addresses both the human and technological aspects of care, and how these can be seen as co-produced and intertwined phenomena. Thus, the study by Bjørnhaug is inspired by these perspectives, and she has sought to build on these frameworks to see what tracking technology becomes when it engages with the Norwegian caring sector and related practices.

In 2011, the use of tracking technology within the Norwegian health and caring services was debated vividly, and addressed frequently at conferences and in public media. At this point in time, few institutions utilized the opportunites for tracking clients. But from interviews with the technology suppliers, it appeared to be a matter of time before such technology would be «normalized» and hence placed under the umbrella of *hjelpemiddelsentralen.* Hence, for the researcher, this situation enabled her to study a technology *«in the making"* (Latour, 1987: 15). She studied several actor constellations, and «gave a voice» to the local users of the technology, the technology specialists and the political experts. Hence, she studied how tracking technology became «*a different thing in different places*» (Müller-Rockstroh, 2007: 3)

Since the technology, at this point in time, was still new within the specfic use area, a range of research and development issues, and research questions, were still not been addressed. In the report «*Praktiske erfaringer ved bruk av lokaliseringsteknologi ved demens*» (Practical experiences using localisation technology in demential care), Dale (2009: 48) points to the need for more indepth research on several aspects of tracking within care, in particular the use of localisation technology within the public health and caring sector. Bjørhaug leans on these considerations in her research approach when she asks how tracking technology is attempted to be reshaped as a potential caring technology within various arenas.

**Analysis and finding in the study**

Within this approach, the researcher uses three arenas for translation. In the analysis of the empircal material that was created in this process, the researcher was inspired by «teknografi» - a theoretical framwork orginally intended for studies of technology transfer across national borders. However, Bjørnhaug has used parts of framework in a slightly different way, and she argues that analytical resources – *script, appropriation, translation, and ways of ordering* – are well suited to describe and analyse how technology meets new contexts, also *within* the same society (cf. Bjørnhaug 2012 for more information).

Bjørnhaug finds, in line with what Müller-Rockstroh (2007) observed in her study of European produced ultrasound technology used in health institutions in Africa, that technology designed for other purposes (i.e. GPS for tracking and rediscovering lost cars and boats), is given new meaning and «done» in particular ways when meeting new actors and new application areas. This supports the general notion within science and technology studies of a multiple reality. Technology is constantly performed or done, rather than being something fixed and singular.

Hence, what tracking technology and care becomes when they meet each other, is affected by several parties, this study shows. They are shaped into something particular on several arenas, through negotiations between actors with both coinciding and contradictory interests.

As such, the line between «good» and «bad», and between «home» and «institution», or between «surveilling» and «watching over», etc appeared to be results of specific practices and contexts rather than something predetermined. What tracking technology then becomes in a new context is not easy to predict beforehand. This could be seen, i.e. through the expectations of some actors that the technology would ease the workday for caring workers. Instead, at the institution studied, a different reality was played out. Some of the caring workers felt that the introduction of new technology rather implied a new and more demanding type of responsibility, and at times a higher workload when gathering tracked people. As a result of this study, it appears crucial to acknowledge the unpredictability of technology when formulating political guidelines and regulations, as well as when designing assistive technologies and implementing routines for technology use at care institutions.

Alltogether, the scenario where a tracking technology is shaped into a caring technology comes with certain preconditions; this «translation» implies open-minded institutions with enough resources to invest both in technological equipment and in increasing the competence of personnel. It implies that the care sector involves technology companies, that (in this case) elderly are mobile, and that the role of care workers are reconfigured as they are given new responsibilities. Furthermore this translation requires that regulation becomes more open to tracking of people in these types of institutions, that technology design makes the tracking unit easy to handle, and that privacy is handled, both institutionally and through built-in privacy features in the technologies themselves.

Hence, for tracking technology to become properly translated into a caring technology, several aspects must be in place, as Pols argues (in Mol et al., 2010: 172-173):

> Devices and scripts have to function in an environment of actual users, other technologies and within specific care settings with their own particular notion of what constitutes good care. These different actors need to be aligned. This can be done by adapting scripts or expectations, or by adapting and accommodating goals and ideals in order to make the devices become recognizable and ‘interesting’ for all concerned. (Pols i Mol et al., 2010: 172-173)

The researcher, in her study at an institution observed that many aspects around the caring context actually was attempted to be adapted to the new tracking situation, but still several pieces were missing; the users felt insecure, the financial situation at the specific department at the institution made it difficult to aquire new tracking units and a «tracking phone», and there at times not enough personnel to retrieve the missing client, and finally there were contradictory perceptions of what «good care» ought to entail.

Hence, the analysis point in the direction of differing perceptions among political actors, the technology provider and the careworkers of how values such as freedom, dignity and safety should be played out in present-day elderly care. This crucial aspect had consequences for how the technology was shaped when meeting a new application area.

# 11 Evaluation and conclusion

In this report we have provided an overview of 9 specific applications of RFID (or similar) technology used in different sectors. The in-depth cases studies conducted show diversity in terms sectors, case-study methods, application areas, and the various user and societal issues that were identified and addressed. The sectors range from *transportation* (toll collection, ticketing), *public services* (library, caring services), *leisure activities* (waterpark, festivals), *sporting events* (marathon) and *retail* (grocery, clothing/apparel).

Through these case studies, we get a richer understanding of how diverse the application areas, and associated (user/societal) consequences, are/may be in the future. Again, we point out that the case studies were conducted some time ago (2010-2014), and today there are a range of other application areas that would have been relevant to study. At the same time, the cases described in this report provide a good picture of the situation in the years after 2010, when RFID was still the primary enabling technology for an IoT-vision that was scarcely treated in public discourse. Now, in 2017, IoT has become a popular topic in media and public discourse, with a range of applications and new innovations on the way.

## 11.1 Case study methods

In terms of case study approach and methods applied, most of the studies reported here involved some initial desk research and literature review. For this purpose, internet search was indispensable, in particular since most of the applications were novel and only documented through less accessible material that primarily could be retrieved through online search engines. Furthermore, some level of fieldwork was employed in nearly all cases, where dedicated researchers were active in the field, participating in the relevant case arenas. They were observing applications-in-use, as well as taking part in personal testing of applications, and conducted interviews and informal talks with relevant actors, stakeholders or end-users/consumers. Field notes were taken, interviews recorded, and in most cases photo documentation was part of the "observation" process. Photos were also used for illustrative purposes in the case descriptions.

## 11.2 Technology, applications and sectors

The main aim of the project was to primarily engage with RFID-based solutions (and affiliated technology). As time passed by, and the discourse around RFID/IoT changed, this criteria was loosened up. Moreover, we see from the case studies that several of the initial visions for new applications and services involved RFID, but that other solutions still were chosen – such as QR-codes (grocery), apps (transport), and GPS (caring). The reasons for this are manifold, but uncertainty due to the novelty of the technology in some sectors, and the cost of complete solutions, were important factors. In some cases other solutions were chosen as a preliminary step towards later RFID (or similar) technology implementation (e.g. QR in grocery), while in others RFID was considered to limiting (e.g. apps in transport).

For the businesses/service providers the main gains from these new solutions are (or potentially can be); *increased efficiency* through automation and self-service (diverting employee resources to other tasks), *cost reduction* (high initial costs, but efficiency gains over time, and potentially less need for manpower), *improved transparency* (in supply chain, inventory control, unique identification of individual items), *increased knowledge of consumer habits* (tracking and profiling through data harvesting from "things"), and potential for *developing new and enhanced services* (using data to build new services, integration of existing services into one service experience), and potential for *continuous engagement with consumers* through post-sale services (via "live" smart devices).

## 11.3 User aspects

A key part of the *RFID in Society* project, guiding the majority of the case studies, has been the focus on user/consumer aspects. In the early phase of RFID (and IoT), the main focus was on industry/manufacturing and the supply chain. Recently – as IoT-services have drawn more public attention, and as more consumer-oriented services have been developed – the potential gains/risks/consequences for users/consumers have become a main priority. Above, we found that one of the main advantages from the supplier/service provider perspective was increased efficiency through automation and self-service. This is also a potential user gain, through more efficient service handling and increased freedom through self-service. To some user groups, this "freedom" may be experienced differently (in a negative way), as less human interaction creates a sense of insecurity and alienation. Cost reduction could also benefit consumers, but depends on the ability of the business side to extract the efficiency gains of new solutions, and their willingness to pass this on to consumers via lower prices. From the case studies, we have seen that this is not always the case (at least in the early phase of implementation).

Improved transparency should aslo benefit users/consumers via the potential for relevant information about products, creating a sense of security and consumer trust. However, this depends on supplier willingness to share "transparency gains". In some cases, suppliers do not intend to share this with consumers, hence upholding the traditional information asymmetry in the market. The tracking and data harvesting from user habits is controversial. This may benefit consumers through more personalised shopping experiences and marketing, as well as on-time information and enhanced services. On the other hand, this vast data extraction (through user profiling, location tracking, consumer shopping habits, transaction logging, etc), which increases exponentially when "things" get connected, put consumers in an extremely vulnerable position in terms of privacy, data management and control. The big data-spreading potential varies a lot, depending on the cases; in some application areas, data are considered valuable both for the specific services, as well as for aggregated services with a societal ambition, and these often include many actors/third parties (extensive data exchange). Other applications are purely limited to a confined service environment, with proprietary solutions and few actors involved, such as the "mini-IoTs" decribed in the case study section (minimum data exchange).

## 11.4 Societal aspects

In the early phases of RFID, the inherent potential of the technology (and the envisionsed solutions) were mainly sector specific, although societal consequences (in terms of surveillance potential and privacy infringement) have been on the agenda for more than a decade (cf. Slettemeås 2009). In the last few years, however, as the vision of IoT have become more dominant in public discourse (through media exposure, and policy and research/innovation priorities), "IoT-related" technology is now considered to be potentially disruptive in many sectors

– and for society as a whole. The consumer segment is identified as the largest "user" of connected things in 2017[68], while IoT is considered to be one of the key enablers for the 4th industrial revolution.

From the case studies described here, some have a more marked societal footprint, while others are mostly sector specific. The solutions affilitated with the amusement/festival/event sectors tend to have more sector-specific consequences. There are minor controversies surrounding these, and they tend to "go below the public discourse radar". These are the "mini-IoTs" already mentioned, which tend to have high impact for the suppliers and the users. For the retail sector, we see that in both cases described, the potential of RFID has not been fully extracted, although, internationally, RFID has been considered to be/become a game-changer for the retail sector. Politically, this technology has also created hope for more transparency in the supply chain and is considered a food safety measure through trace and track capabilities.With limitied public discourse in Norway (although some major debates and public outcry have been identified in other countries over the years), the retail sector is yet at an early stage regarding this technology, and the general societal impacts are only moderately distinguishable.

For the transportation sector, RFID and related technological solutions, have already had great impact, particularly in the two cases studied here (toll collection, public transportation). The user and sector gains have already been considerable, and the societal impact can be seen through improved transport/traffic management and less queuing. At the same time, there has been public debate about the surveillance and function creep potential in this sector (in addition to failed investments), and the general potential for privacy infringement. This sector will experience radical change over the next years through "connected cars", "smart traffic" solutions and "smart city" priorities.

Lastly, in the public service sector, the two cases illustrate somewhat different societal impacts. The library sector experiences a low key transition to more efficient services, while the caring sector (and the technologies discussed here) are directly tied to a larger welfare/assistive/caring technology debate and the societal challenge of an ageing society. Although some surveillance/privacy aspects have been raised – as well concerns about less user control, more automation, and less warm hands vs more cold technology – there is a focus on how this technology can contribute to more safety, security, social participation, mobility and physical and cultural activity for the increasing elderly population.

* * *

This report is the second deliverable in a series of four. It continues from the first deliverable, which identified criteria for selecting and structuring cases, and which presented a preliminary description of selected RFID/IoT-services. In this second report, we have employed the exploratory/descriptive "multiple case-study" design on 9 selected cases, and evaluated these.

In the next report (deliverable 3 of 4) we consider methodological aspects of the research project as a whole. This is done by reviewing the academic publications stemming from the *RFID in Society* project, and their epistemological and methodological positions.

[68] Cf: https://www.enterpriseinnovation.net/article/consumer-products-dominate-iot-2017-840451547

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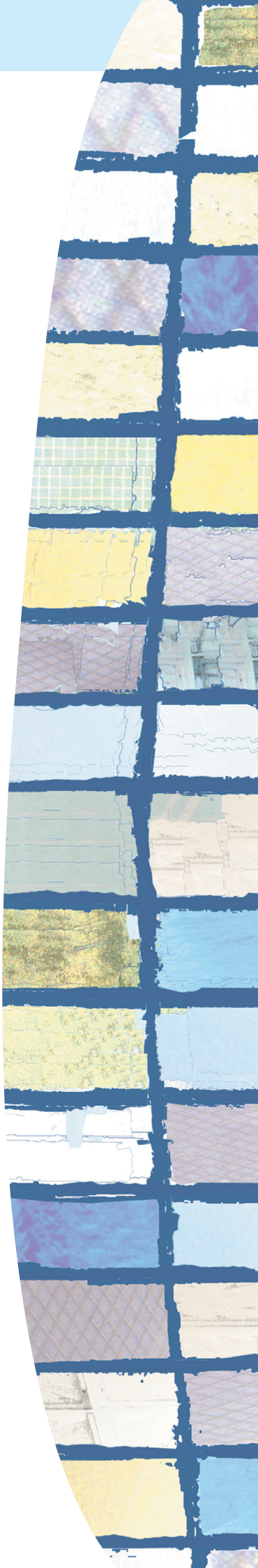
Consumption Research Norway SIFO at Oslo and Akershus University College of Applied Sciences (HiOA) has a special responsibility to contribute to the knowledge base for consumer policy in Norway and will develop new knowledge about consumption, consumer policy and consumer position and role in society.

Key research topics are:

- consumers in the market and consumer choice
- household resource allocations
- consumer economy - debt development and poverty
- technological development and consumers' every day life
- digital daily life and coping
- environmental effects of different types of consumption
- food and eating habits
- textiles - value chains - consequences for everyday life and environment
- consumption significance for social inclusion
- consumer policy



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