

Zoltan KATO

Faculty of Business and Tourism, University of Economic Studies, Bucharest, Romania

USING RFID AND GIS TECHNOLOGIES FOR ADVANCED LUGGAGE TRACKING

Empirical
studies

Keywords

RFID tags
Shipment
Track

JEL Classification

M11, R41

Abstract

By purchasing a plane ticket or a cargo service, the passenger or the customer signs a contract with the airline company. From that moment on the airline company is responsible for all aspects of air travel, including the passenger' luggage (recording, handling to / from the aircraft etc.). Safe transport of passengers' luggage or cargo packages on airlines raises numerous problems for airlines and requires flexible, efficient solutions, appropriate to the specific requirements of each client. Annually millions of luggages get lost in airports around the world. This causes inconvenience to passengers and loss of resources and additional costs for the airlines. The aim of this paper is to examine how RFID(Radio Frequency Identification) technology could be useful for advanced shipment tracking (Track&Trace) in the airlines industry, by using rewritable passive RFID tags.

Introduction

Mishandled luggage by airline companies is a sensitive subject that can compromise a long-awaited vacation, in detail planned business, or disturb, annoy and cause discomfort to the concerned passengers. Although most of the "lost" luggage are finally found, the delay is frustrating and expensive.

The term of "mishandled" luggage in aviation industry, applies to all luggage that have been delivered late, damaged, lost or stolen after being checked and taken over by the airline company. The reasons of mishandling are "omissions" in the system that can be human error, malfunctions in automated systems which move the luggage from check-in to the aircraft, or the very short transfer time.

So why does luggage go missing? Rhiannon Orzellca, luggage services manager at Virgin Atlantic, says that the biggest challenge is connecting flights with short connection times and multiple airlines being involved (Dykins, 2014).

There are well-established modern technological innovations that can be applied to improve and implement an integrated track system for luggage in airports. Such an innovation is the RFID technology.

1. Facts and trends for mishandled luggage

The airline industry is struggling to provide passengers with access to real-time information for tracking improperly handled luggage. The airlines try to be more proactive with improperly handled luggage claims at the airport and allow passengers to self-process the claims for delayed luggage. According to "Air transport industry report - The baggage report" (2014), in 2013 3.13 billion passengers have used the air transport (increasing by 5.1% from 2.98 billion compared to 2012), of which have been 21.8 million cases of improperly handled luggage (down by 17.2%, from 26.3 million cases in 2012) and 6.69 per 1,000 passengers have had a problem with improperly handled luggage (down by 21.2% from 8.83 per 1,000 passengers in 2012). The Short term trends for mishandled bags are presented in Figure 1.

While many of us will have experienced first-hand the difficulties in claiming back compensation from airlines, if successful, passengers are now entitled to up to the equivalent of 1,170 US dollars per bag under the Montréal Convention (Cann, 2014).

Looking at the details for 2013, delayed bags comprised 81.2% of the total mishandled bags, down from 82.8% in 2012. Damaged or pilfered bags account for 15.5% of mishandled bags and 3.3% were declared lost or stolen. By calculation based on IATA's (the International Air Transport Association) estimate that a mishandled bag costs the industry 100US dollars. Annual mishandled

bags cost the industry a total of US dollars 2.09 billion in 2013. The Long term trends for mishandled bags" are presented in Figure 2. The past ten years have seen passenger numbers grow by 65.6%, from 1.89 billion in 2003. The mishandled bags per thousand passengers across region are presented in Figure 3. The total number of bags mishandled reduced by 12.5% across the ten years and the total bag mishandling cost to the industry was cut by 6.4%. (Air transport industry report. The baggage report 2014).

Until December 2014, according to the report of "AirGuide For the Frequent Flyer" (Which Airlines Lose Your Luggage The Most, 2014) the five worst airlines for baggage handling through the first nine months of 2014 are:

- Envoy Air (formerly American Eagle): 8.82 reports per 1,000 passengers.
- ExpressJet Airlines: 5.82 reports per 1,000 passengers.
- SkyWest Airlines: 4.78 reports per 1,000 passengers.
- Southwest Airlines: 4.31 reports per 1,000 passengers.
- American Airlines: 3.76 reports per 1,000 passengers (Which Airlines Lose Your Luggage The Most, 2014).

Lost luggage is usually caused by negligence. The recent congressional hearings reviewed industry statistics showing that causes of delayed luggage were as follows:

- Transfer luggage mishandling 61 %
- Failure to load at originating airport 15 %
- Ticketing error / passenger bag switch / security / other 9 %
- Loading/offloading error 4 %
- Space-weight restriction 5 %
- Arrival station mishandling 3 %
- Tagging errors 3 % (Franks 2007).

2. Luggage transport operations at the airports

In principle the baggage transport between the check-in terminal and the airplane is accomplished by using very simple transport solutions, of manually loading and reloading the baggage. Luggage trolleys are used to transport them directly to the plane. Loading and unloading of luggage is made manually.

In the last decade the luggage handling technology in airports became more sophisticated. The short time of trans-shipment means that baggage must be handled quickly and efficiently.

The imposed solutions are influenced by the physical characteristics of airports. If the luggage is travelling only short distances there are used handling systems based on conveyor belts that can provide cost-effective solutions. If the luggage must travel a longer distance (and faster) than the high-speed solutions such as destination coded vehicles (DCV) which can move the luggage

quickly around the airport, while ensuring their trans-shipment minimum are applied.

The present situation can be described as follows:

- The luggage, labelled with the destination address, is taken over at the exit of the terminal usually by two persons of the ground staff (truck driver and ground worker), who manually arrange the luggage on luggage trolleys. This operation is performed in rather chaotic ways, resulting in the mutual pressure of individual units of luggage, and which in turn can cause the potential damages.
- This transport process is usually supported by wheel sets, which consists of 4-5 trucks, all connected with the front mover. When the loading space is fulfilled up to maximum, the whole sets are transported from terminals to waiting airplanes (within terminals or internal taxing areas).
- After reaching the airplane luggage hutch area, the luggage units are manually located on the conveyor belt. Then they are moved by the conveyor to the airplane hutch and placed within cargo space of the airplane. Usually this operation is conducted by two persons of the ground staff (driver and manual worker) (Hentschel, et al.2012).

3. The luggage identification solution with RFID

According to the current safety requirements there is a need to create a new transport system, which works in a closed cycle and is based on "smart" identification devices with passive RFID tags for automatic loading and unloading the luggage.

The technology and the possibility of using RFID tags to identify the luggage in airports is available for more than a decade but so far it was not used by airlines. It is assumed that the main reason refers to the costs:

- of the RFID tags (which should be charged to passenger or could reduce the carriers profit)
- of the modernization of tracking systems; An RFID system is always made up of two components (Figure 4):
 - the transponder, which is located on the object to be identified;
 - the interrogator or reader, which, depending upon the design and the technology used, may be a read or write/read device (the data capture device is always referred to as the reader, regardless of whether it can only read data or is also capable of writing) (Finkenzeller 2003).

Passive RFID systems are distinguished from active RFID systems primarily by the absence of an internal power source in the tag. The lack of an internal power source yields both advantages and disadvantages to the RFID system designer.

The major advantages of passive RFID systems include:

- Lower expenses
- Smaller sizes
- Greater operational life
- Environmental robustness (Jones & Chung 2008)

To begin the introduction baggage tracking with RFID tags, it will be necessary for a parallel use of traditional system (with bar codes) with the new system. At the check-in the passengers give over the luggage to be loaded in the plane. Each piece of luggage, in addition to traditional barcode strip, receives a passive RFID tag. On it there are inscribed all data for the passenger's flight, and GIS data (Geographic Information System) for interim transfers and final destination.

A geographic information system (GIS) is a system that is designed to capture, store, manipulate, analyse, manage, and present all types of spatial or geographical data.

Luggage for the same destination collected and stored with the luggage that arrived faster to the same destination. When the system requests it, the collected luggage in a certain period of time for that flight arrive at a "make-up zone". Thus instead of the luggage due to arrive within a period of several hours, all baggage arrive in make-up zone in a much shorter period of time, where the luggage handlers or robots quickly prepare the containers for flight.

At the luggage handling, at each insertion / removal from a luggage perimeter, the transaction is recorded in the RFID tag attached to it. If wrong handling or placing of a luggage occur in an area with a different destination, the system triggers a warning sound and light flashes in the perimeter. Thus by checking with a portable reader the operator can identify the correct location for the "lost" baggage.

The containers themselves have readers, and if they are loaded with a luggage with a different destination, triggers warning with sound and light and triggers the corrective operation.

RFID tags work via radio frequencies (compared to lasers used for barcode readers) so there is no need for direct access between the reader and the RFID tag. This provides a 99% of reading rate of the luggage with RFID tag and at the same time means that it is less likely to be lost.

At each change of location of the luggage is added new GIS data, who enrol in both: at the RFID tag and in database of the tracking system.

At the moment smart mobile phone applications can be developed, through which the traveller who knows his RFID tags ID's can identify the location of his luggage.

4. Conclusion

We believe that through technological progress in the last decade it has greatly increased the storage capacity of the passive RFID tags and their cheapening and it is time for widespread use in passenger air transport industry.

As a proof if you have flown via Hong Kong International or Las Vegas during the past years, your luggage will have had an RFID tag attached.

Since the summer of 2013, British Airways tested reusable digital bag tags that incorporated RFID technology.

Acknowledgements:

This paper was co-financed from the European Social Fund, through the Sectorial Operational Programme Human Resources Development 2007-2013, project number POSDRU/159/1.5/S/138907 "Excellence in scientific interdisciplinary research, doctoral and postdoctoral, in the economic, social and medical fields -EXCELIS", coordinator The Bucharest University of Economic Studies.

Reference list –

Journal articles

- [1] Cann, C. (2014). How to handle lost baggage. *Travel Trade Gazette UK & Ireland*, (3124), 46-47.
- [2] Dykins, R. (2014). Handle with care. *Business Traveller (Asia-Pacific Edition)*, 56-59.
- [3] Franks, M. R. (2007). Airline liability for loss, damage, or delay of passenger baggage. *Fordham Journal Of Corporate & Financial Law*, 12(4), 735-752.
- [4] Hentschel, B., Richtsteig, G., & Górski, K. (2012). Automation of the logistics chain in the form of an innovative concept container transport system for luggage handling at airports. *Logforum*, 8(3), 231-244.
- [5] Air transport industry report. The baggage report (2014), Retrieved from <http://www.sita.aero/surveys-reports/industry-surveys-reports/baggage-report-2014>
- [6] Which Airlines Lose Your Luggage The Most. (2014). AirGuideFor the Frequent Flyer, 9. Retrieved from <http://eds.a.ebscohost.com/eds/pdfviewer/pdfviewer?vid=18&sid=558248be-8dff-464b-ba9a-33eb0851c706%40sessionmgr4005&hid=4103>

Books

- [7] Finkenzeller, K. (2003). *RFID Handbook: Fundamentals and Applications in Contactless Smart Cards and Identification*. England: John Wiley & Sons Ltd.
- [8] Jones, E. C. & Chung, C. A. (2008). *RFID in logistics : a practical introduction*. New York: CRC Press.

Appendices

Figure 1. Short term trends for mishandled bags



Source: Air transport industry report. The baggage report (2014)

Figure 2. Long term trends for mishandled bags



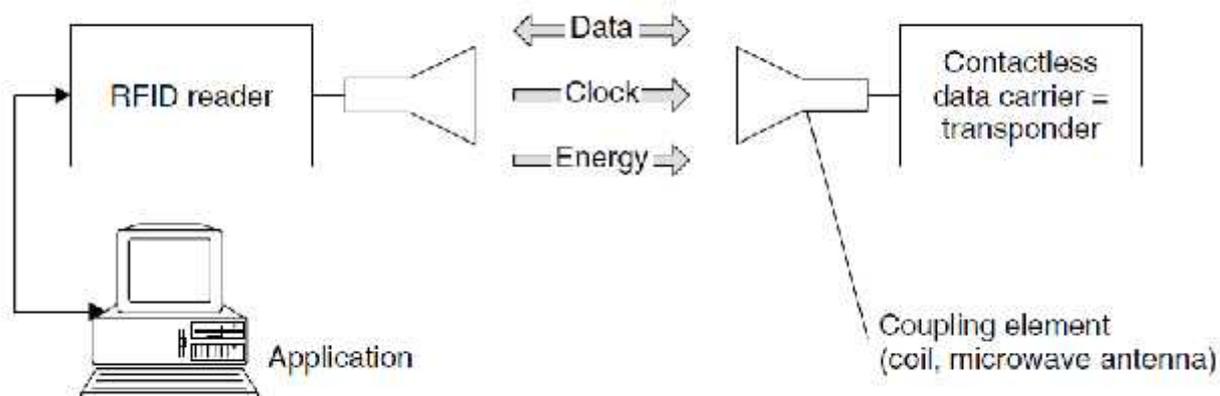
Source: Air transport industry report. The baggage report (2014)

Figure 2. Long term trends for mishandled bags



Source: Air transport industry report. The baggage report (2014)

Figure 4. The reader and transponder the main components of every RFID system



Source: RFID Handbook