

CETRA²⁰¹⁴

3rd International Conference on Road and Rail Infrastructure
28–30 April 2014, Split, Croatia

Road and Rail Infrastructure III

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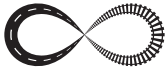
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STORE&GO⁺ – NEW PASSENGER SERVICES BY NEW BAGGAGE STORAGE ROBOTS

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Abstract

In order to gain attractiveness and high comfort at rail terminals the effective function and design of public baggage storage services gets an essential success factor in near future. At intermodal traffic stations the necessity of quick passenger transfers in short periods of time is very essential. In addition there will be increasing demands for real comfortable temporary deposits for luggage or shopping bags, too. Conventional luggage lockers are inefficient concerning utilization of space, which is limited at most railway stations. Effective depot services have to be accessible with ease for the passengers, too. Modern depot services also need to be available for old or handicapped passengers.

Store&Go⁺ is a new integrated concepts for modern railway stations. It provides multifunctional benefits for travellers, local service providers and the retailers at terminals. The new Store&Go⁺ depot service represents an innovative system for short term and long term storage of traveler's luggage at railway stations, but is also foreseen to be used as pick-up place for internet shopping or as parcel buffer at distribution hubs in the logistic industry.

Store&Go⁺ addresses the utilization of unused free space of buildings, increases safety and comfort for travelers. The System increases the attraction of public transport in general. Store&Go⁺ represents an innovative cube adaptive storage technology as well as a novel concept in effective warehousing and handling of parcels and luggage. It integrates a completely new boxing system and a warehousing robot. Store&Go⁺ can be used in house at railway stations and as outdoor module at open air platforms. This paper describes the experiences with a prototype and the learnings of user acceptance tests, executed by an Austrian research consortium.

Keywords: railway station, baggage storage, warehousing robot

1 Introduction

Future railway stations and similar hot spots of public transportation need to address changing mobility demands of travellers. In a research study funded by the Austrian “FFG” (Austrian Research Promotion Agency) requirements and demands for temporary storing possibilities of luggage in railway stations were investigated. This study [1] is based on a broad investigation of essential traveller requirements and expectations for future luggage storage systems. Modern public storage services should be available in short-term and medium-term simply to avoid troublesome handling of luggage and significant stress factors for all passengers. The release from luggage and an easy to use deposit during waiting times at the station or for business or touristic reasons is an important factor to increase the attractiveness and efficiency of public transportation systems in general. Beside short travel connections and centrally located railway stations public transport also requires just comfortable depot systems. After initial investigations and fact findings an Austrian research consortium developed a new and innovative depot system (named Store&Go⁺) as experimental prototype for passenger's

luggage or baggage. This Store&Go+ system represents a new cube adaptive technology for containers which can be top loaded at extremely user friendly drop stations. The system incorporates a novel concept for effective warehousing and handling of luggage, too. The construction details provide integrated answer to the needs and expectations of all kind of potential users and address the needs and operational conditions of station operators, too. In order to integrate demands from different perspectives the Store&Go+ prototype was developed during a two-year inter-university research collaboration of the universities of applied sciences in Steyr, Wels and St.Pölten in alliance with the Viennese research company netwiss. The Austrian Federal Railways “ÖBB” and the leading Austrian logistics systems integrator “TGW” joined the research team as practical think tanks, too and the development was funded by the Austrian Research Promotion Agency “FFG”.

2 The new perspective for railway station operators

Public transport hubs (e.g. train stations or airports) of the new generation are changing more and more into multi-functional business centres and do not only offer the travel, but also a local shopping, business communication and shopping service. In this context, the troublesome handling of luggage constitutes a significant stress factor and a loss of comfort for all passengers.

The developed Store&Go+ concept provides an easy way of luggage deposit and overcomes the disadvantages of conventional locker systems (e.g. the difficulty of handling of heavy luggage, which is deemed acceptable to older or weaker travellers). Instead of side or front loaded lockers the Store&Go+ system uses specialised 3-sided containers which can be filled from the top and from the front side at automated loading stations in ergonomic working height.



Figure 1 Disadvantages of conventional locker systems compared with an ergonomic and easy to handle drop station

To protect the personal belongings of the user each container is covered and sealed automatically before its transfer into an automated storage area. Fully automated and industrially standardised storage and retrieval systems (“Commissioner”) – which are already well established and approved in many installations store the closed and locked container into a background racking system. In parallel the user gets a barcoded ticket to pick up his luggage again whenever he likes.

For the railway station (or airport) operators – who are very often in lack of commercial space – the partially patented Store&Go+ technology enables the efficient utilisation of free space heights within the station infrastructure as a storage room for passengers luggage containers. The Store&Go+ system represents a solution, both technically and economically explored and examined for feasibility, which can be used not only in the planning of new stations, but also for existing buildings. Even open air installations at very small stations or in pedestrian zones are technically possible.

The central idea of Store&Go⁺ is that travellers (or any other passers not traveling) can check in their baggage in close proximity to high frequented parts of the station – like near the front entrance, or the exit of subway stations, or at taxi stand – quickly and easily into an automated luggage depot. In this way, relieved from the efforts of luggage future passenger increasingly may make use of the commercial centre of the railway station (e.g. restaurants, shops, travel agents, communication infrastructure, catering or the facilities for local supply, etc.). Before departure or before leaving the station the customers also easily can retrieve their luggage again.

Through the development possibly existing acceptance barriers were countered in upfront, too. So the Store&Go⁺ concept is a technological answer to meet all the demands and challenges of modern depot services. The system is also foreseen to be used as pick-up place for internet shopping in a self-service automatic unit.

3 Ergonomics and the user's perspective

In order to enable best user acceptance and customer-friendliness a prototype of the drop and pick-up station was built before detailed final construction steps were executed. More than 150 persons in all categories were interviewed and had to fill out structured questionnaires after testing different possible ways of operation.

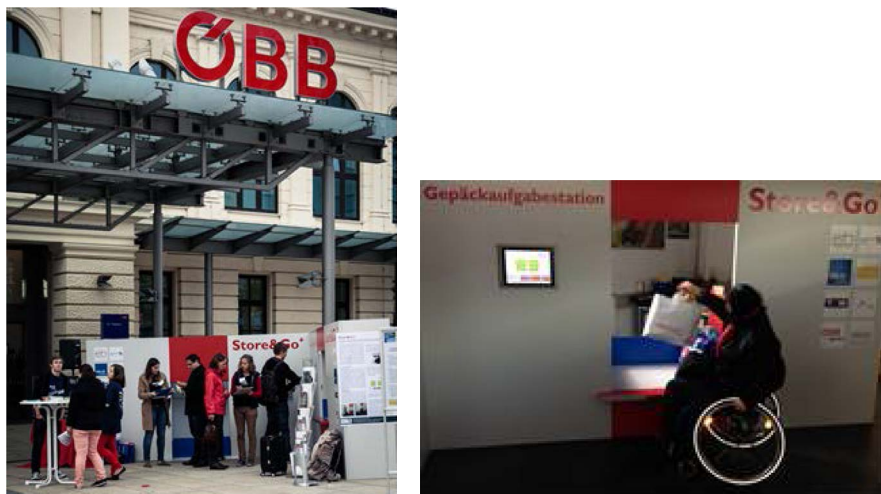


Figure 2 Store&Go⁺ prototype tests with all potential user groups

Beside the cost for the individual storage period an easy handling of luggage lockers is the essential criterion for user acceptance. The handling consists of easy locating and supported lifting up the luggage and of self-explaining software dialogues. Also fast return of the luggage is essential. Most important is also the size of the lockers and the fact whether the luggage must be lifted or not.

Depending on the age and sex travellers have got different difficulties when they must lift luggage. For example about 50% of all female passengers with large luggage are not able or willing to lift it, about 20% are able or willing to lift it up to about one meter and only 30% are able to lift it higher.

For about 70% of all female and 40% of all male travellers storing luggage at low level is important. Also for 70% of all passengers above the age of 60 this is a must.

The time needed for storing and especially for getting back the luggage is another very important criterion for acceptance. More than 25% of the asked train passengers say the luggage

returning must not need longer than one minute, more than 50% accept a time need between one and three minutes. The time need includes the whole process between coming to the locker until getting the luggage and leaving. Especially the subjectively felt time needed when passengers are in a hurry and they are nervous because of the approaching departure of their train is very important.

Many of today's lockers are too small for usual luggage items. The width of many lockers is 33cm but 40% of all luggage items are bigger than this size. That means 40% of luggage items do not fit into normal lockers. Passengers either cannot store it or must use a much more expensive locker for huge items.

It was analysed, that about 80% of passengers staying more than 30min at the station think about using a short term locker for easier moving in order to use the station infrastructure like shops or bistros. For half of them the handling must be very quick and cheap.

4 The Store&Go+ system solution

With regard to an utmost universal use the Store&Go+ system is designed for all the fields of railway transport, aviation and other hot spots of public places to be available for commuters, passengers and shoppers. But the focus of this development, however, must depend on railway stations.

4.1 The focus on passengers healthiness and comfort demands

Core of an automatic and public luggage storage system must be an ergonomic, robust and tailored design, which fits to the needs of all kind of user groups. Any differences, such as age, gender and physically or mental health should be irrelevant. This means that an old person shall be able to deposit luggage, such as anyone using a wheelchair or a woman with a baby buggy.

The user interface principally has to meet the requirement of the general population. The dimensional design for physiological user heights and gripping areas directly result from the ergonomic body reference. These requirements for a physio-friendly and ergonomic operation have to be supplemented with barrier-free equipment for people with technical restrictions (disabled).

Also the cognitive system requirement factors have to be taken into account for the software and screen design of the user interface. Multilingualism in the user dialogs and the use of readily understandable pictograms and colours have to be applied even for colour-blind people. All operating functions must include logical (= the common expectation appropriate) operating dialogues with any function cancel option for all starting and operating steps with online help function.

All these specific human related requirements have to be added by standardized safety and comfort requirements, ranging from rounded bearing edges for protection against bruises to the exclusive use of simple controls which avoid users to be jammed.

4.2 The technical solution

As part of the research project Store&Go+ both the technical and economic feasibility has been proven. Finally the layout is characterized by the user friendly top and side loading philosophy and by a container volume adaptive handling technology.

The warehousing technology is based on proven and reliable automation concepts of industrial small part warehouses, which is combined with the innovative top and side loading container system to meet the conditions and demands as defined above. The key solution element is the cube adaptive container system which includes the covers (negative boxes) and cover locking.

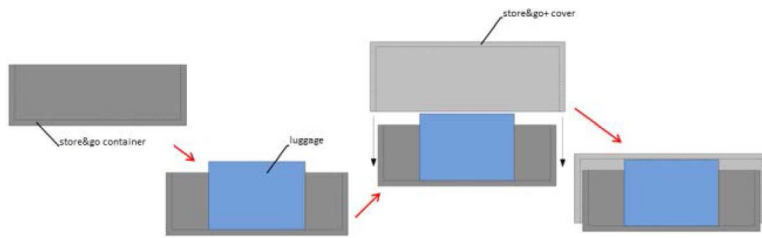


Figure 3 Store&Go+ container topping function

Requested stability and robustness soon results in a materials selection of metal and the following frameworks specifications:

- Framework of the resulting criteria for the container construction:
 - large dimension: length: 100cm, width: 60 cm
 - small dimension: length: 50cm, width: 60 cm
 - max. luggage height 50 cm
 - resistant against vandalism and stealing
 - generally easy and simple mechanic for low maintenance cost
- Framework of the cover criteria:
 - The cover has to be secured in both directions (lifting and lowering of the lid) in case of swelling luggage (e.g. when it opens autonomously)
 - Automatic capping and uncapping takes place inside of the system in order to avoid bruising of the passenger.
 - An automatic control of the filling level is necessary.
- Resulting criteria framework for the construction of the Pick Station:
 - Pick station have to operate for the luggage deposit and the pickup.
 - Because of performance reasons a pick station (luggage input and output terminal) shall not serve more than 150 stock locations (bins).
 - Payment shall be able to be settled by use of vouchers, international credit cards and money. Instead of returning cash back vouchers may be issued.
 - The output orientation of the container shall be the same as for the input task. This allows easier gripping the handles or straps of the luggage.
 - A control of the container filling levels is realised by use of cameras and scales.
 - Mounted mirrors support visible inspection of the luggage place-ment in the container as well as the inspection of emptiness after outtake.
 - In case a container is not emptied completely by the customer, it must be stored again automatically.
 - The container must be transported underneath its supporting guides to the loading position in such a way, that no customer items are able to fall out. (e.g.: everything falling out of pockets has to fall into the container only.)
 - Any danger of bruising or crushing has to be excluded.
 - The handling height (minding disabled persons) is 40-60 cm.
 - The max weight of luggage shall be about 35 kg per container.
 - Initial height measurement or control of overhangs should be done before the move to the inner part of the station takes place. The control of emptiness or of maximal filling levels might be supported by pictures, which are taken within the station, where lighting conditions can be kept constant.

The automatic storage and retrieval system incorporates a lifting beam designed for optimum volume utilisation and maximum performance. The warehouse module may be installed across a length of up to 10m and can be used at building heights of up to 18 m. It accommodates a load handling device for single-deep storage of the covered containers.



Figure 4 Store&Go+ commissioner as storage module

5 Conclusion

With the concept of Store&Go+ a concrete technical system has been developed for the innovative deposit of luggage in self-control robots. It is characterized by both a volume adaptive container technology as well as a novel luggage storage technology using racking systems and conveyors. This directly addresses the quality objectives of an effective luggage deposit service, but also the performance targets and passengers comfort.

Travellers will purchase more at the station whenever they can deposit hindering items. Store&Go+ enables station managers to meet this need and by means of offering a new attractive service they will increase the attractiveness of public transport in general, too. The easy to understand self-service function is not only a guarantee for good “usability” and user acceptance, but also facilitates urban mobility and stimulates the motivation to use public transport.

The Store&go+ system addresses especially changing travel behaviours at rail-way stations, which increasingly will serve not only as enter or exit stations of public transport but also as centres for communication and the daily shopping. The replacement of existing locker systems by Store&Go+ systems shall not only address the baggage depot service, but also has the potential for use dor the Lost &Found department at stations. Furthermore, the new system is ready as pick-up station of internet shopping and for the daily needs of commuters and other travellers. The internet and its constant accessibility via smartphones not only change the communication and mobility but also the purchasing behaviour of working people.

The vision of Store&Go+ provides a functional response to the growing demands of the changing mobility behaviour at traffic stations. Travellers (or any other user groups who are not traveling) shall be able to quickly, easily and ergonomically place their luggage in automated self-service depots and always pick it up again quickly after a simple payment process.

The Store&Go+ system is designed in modus to be implementable in adaptable sizes and scalable storage capacities at railway terminals or airports.

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