



The way forward?

Stephen Bennett and William Gibbs of consultants, Swanson Rink, look at the business case for the introduction of Individual Carrier Systems for baggage handling at US airports.

There are a number of advanced baggage handling system (BHS) technologies that have been implemented in Europe and other parts of the world, but have yet to be embraced in the United States.

One of the more intriguing technologies is the Individual Carrier System or ICS. European airports that have successfully used ICS include Munich, Heathrow, Barcelona, Oslo and Helsinki.

We have heard arguments that the ICS is too expensive and the benefits don't justify the added cost; so we decided to find out for ourselves.

Swanson Rink sought to determine if there is a business case for ICS in the United States. We started with a BHS project that is to be built in the US in the near future; a project of moderate size and complexity, with typical domestic loads similar to those at many major US airports.

Our study made a comprehensive comparison of ICS technology and traditional conveyor technology, applied to a typical airport baggage handling system.

The main differences

An ICS baggage handling system differs from a conventional conveyor system because it uses individual tubs or carts to convey baggage, instead of conveyor belts.

Though there are hurdles for utilisation in the United States, a strong argument can be made for ICS and we believe that it deserves a closer look.

We found that the ICS delivers improved baggage delivery both to and from aircraft. In addition to reduced travel time and reliable delivery energy usage, there are fewer tug train incursions on the apron,

there is a smaller carbon footprint, and operating costs overall are reduced significantly.

In the ICS model, the travel time from aircraft to baggage claim, as well as check-in to make-up, is more direct and has the potential to minimise ramp traffic.

On inbound, tug trains travel a much shorter distance from aircraft to load pier which can be located near the aircraft rather than back at the terminal. Bags are loaded on containers and transported via ICS back to baggage claim, thus avoiding the drive back to the main terminal in the traditional approach.

Tug traffic in the vicinity of active gates is minimised and the risk of fallen and damaged bags is reduced.

The advantages of ICS can be further increased if a common-use business model is employed for baggage handling. ICS requires fewer tugs and carts, thus the number of bag handlers can also be reduced. Costs can be substantially less where resources and related expenses can be shared.

Another benefit of ICS is the convenient application of Early Bag Storage. Since ICS uses RFID labelling on all tubs, vertical storage is practical, and Just-In-Time Delivery to outbound sort carousels can be accomplished.

Make-up is easier and less risky since only bags for the particular flight need to be delivered to the make-up carousel or pier; there are fewer lost bags by virtue of limited manual intervention for sortation. Early bag storage can also improve the efficiency of baggage screening operations when applied as a load levelling facility upstream of the baggage screening matrix.

TSA operating costs

Cost Centre	Traditional BHS	ICS
BHS Maintenance (spare parts)	\$947,000	\$1,295,000
BHS Maintenance Staffing	\$3,733,000	\$3,344,000
BHS Utilities (electric power)	\$132,000	\$176,000
Tug Maintenance (parts, labour)	\$776,000	\$400,000
Bagroom Staffing	\$14,648,000	\$10,571,000
Tug Power	\$158,000	\$54,000
EDS Maintenance	\$420,000	\$420,000
TSA Staffing	\$13,800,000	\$10,200,000
EDS Utilities (electric power)	\$13,000	\$13,000

Cost centres

The next step of the analysis was identification of the major cost centres associated with ownership of a baggage handling system. Cost (and by extension, benefit) centres were assigned to stakeholders as they are traditionally found at most US airports.

The ‘airport’ was deemed responsible for procurement, construction and basic operation and maintenance of the baggage handling system’s physical plant.

In our models, the ‘airlines’ are responsible for outbound and inbound bag room operations. The airlines may operate autonomously, or may form a consortium, which provides operational and maintenance services for the airlines collectively.

Activities such as staffing for the bag rooms, and ownership and maintenance of the baggage handling tug and cart fleet (which transports baggage to and from the aircraft) flow to the airlines.

Baggage screening is the responsibility of the TSA. TSA provides the screening equipment, which is a major portion of the baggage handling system, and they are responsible for staffing the screening matrix.

BHS models

Detailed system models were created for each system. The design concept was based on a peak flow rate of 2,750 bags per hour (BPH) outbound and 3,500 BPH inbound, with 12 load points including ticket counter positions, kerbside drops and remote check-in, and 18 inbound load piers (This is an arrangement common to many mid-size airports and large airports with multiple terminals).

Surges, jams and component failures were also addressed. Performance models assume a maximum of 23 concurrent outbound flights and 16 concurrent inbound flights.

There are two major operational differences between ICS baggage handling technology and traditional conveyor technology. The first difference is that the ICS system is a loop rather than a one-way delivery system.

Tubs are circulated around the loop and returned to the baggage load points as necessary for baggage transport. The loop design offers a natural path for inbound baggage transport to

claim devices, eliminating the need for a substantial amount of tug traffic on the apron.

The second difference is that an ICS uses containers to separate and transport bags. ICS containers (tubs or totes) are consistent in size, and are larger than ordinary baggage.

Larger tub size (48” versus 30” for the bag alone) reduce the processing capacity of the EDS scanner by approximately 25% compared to a traditional BHS. This reduction in capacity can be partially offset by the improved processing accuracy of the ICS system.

The model for the traditional BHS was developed following normal industry-accepted design practices. BHS sub-systems include airline-dedicated baggage loading points, baggage transportation to common mainline conveyors, integrated inline baggage screening, checked baggage reconciliation, outbound sortation delivering baggage to airline-dedicated sort carousels, and airline-dedicated inbound baggage handling and baggage claim.

Passenger ticketing and outbound baggage loading is accomplished on the departures level at dedicated airline ticket counter positions. Unscreened baggage is collected onto two delivery mainline conveyors and transported to the checked baggage inspection system (CBIS) screening matrix located on the ramp level at the junction of the terminal and concourse.

The CBIS contains five active (plus one standby) EDS scanners and their complement of Level 3 baggage screening stations. Screened baggage is transported via two mainline conveyors past two manual encode stations to outbound bag rooms located at the ramp level.

Inbound baggage is collected from arriving aircraft and transported via airline dedicated tugs and carts to specific inbound load piers located on the ramp level. Inbound delivery conveyors transport baggage to their respective claim units located on the arrivals level.

The model for the ICS-based BHS was developed following manufacturers’ recommendations and industry best practices as they apply to an ICS design.

As with the traditional conveyor belt system, passenger ticketing and outbound baggage loading is accomplished on the departures level of the terminal.



For ICS however, unscreened baggage is loaded directly into individual containers (tubs) at the ticket counter load points, collected onto delivery mainline conveyors and transported to a pre-CBIS bag storage/screening load levelling facility. The number of scanners and screening stations is the same, in part due to the pre-CBIS bag storage.

Operations and maintenance costs

Operational costs for the baggage handling systems considered the number of staff per shift, spare and replacement parts, original equipment manufacturer (OEM) maintenance contract costs, and electrical power consumption by the respective systems.

Costs associated with operation of the inbound and outbound bag rooms are similar and include the costs for tug power consumption, maintenance, and staffing to load transport and unload baggage.

TSA operational costs include screening matrix staffing and OEM maintenance contracts. Operations and maintenance costs on an annual basis are listed in the table on the previous page.

Passenger experience

Ticketing and baggage claim have been identified as areas where innovative baggage handling system design and operation could improve the passenger experience.

Innovations such as self-check-in and bag tagging can be applied to either BHS technology. ICS technology offers the opportunity for performance improvement in delivery of inbound bags to the claim devices.

Passengers expect their bags to be present when they reach the claim unit at their destination, and ICS is very effective on inbound baggage delivery. We performed dynamic simulations on traditional and ICS designs, which considered the time to unload the aircraft to carts, drive to the stripping belts and unload the carts to the carousels.

For the traditional design, the first bag arrives at the claim device 22 minutes after flight arrival, 50% of bags are delivered within 40 minutes, and 95% are delivered within 77 minutes.

For the ICS design, the first bag arrives 20 minutes after flight arrival, 50% of bags are delivered within 36 minutes and 95% of bags within 50 minutes.

In the ICS option, the tug trains travel from aircraft to load pier(s) located along the concourse, avoiding the majority (if not all) of the aircraft parked at or approaching/departing the gates.

For a traditional design, tug traffic travels on the ramp from the aircraft to the inbound load piers located in the terminal. Tug traffic in the vicinity of active gates must stop and wait for arriving or departing aircraft to pull in or push back from the gate before proceeding to the terminal. These delays are random and add approximately five minutes to the baggage delivery time.

Accountability and transparency

Traditionally baggage is tracked using ‘photo-eye’ sensors and belt speed to determine its location.

Barcode tags may be tracked, but that technology is expensive and most reliable when their laser heads are clean. Common performance of barcode reader arrays is 85% accuracy, unless the laser heads are kept meticulously clean. Hand-held barcode readers have better performance, but often require excessive lengths of time to achieve a successful tag read.

ICS containers are fitted with a permanent RFID tag, which uniquely identifies the tub, and tracks the bags through the system. The result is the tracking accuracy rises to 99% with ICS, and possibly higher depending on the complexity of the system. However, to assure this level of accuracy the bag must remain in the tub for as long as possible from bag drop at check-in to the aircraft.

The BHS control system can accurately report bag location at many more locations within the BHS, making the system operator accountable and making it possible to inform passengers where their bags are, and when they made it onto the aircraft.

Total cost of ownership

Initial construction costs for an ICS based BHS is higher than for a traditional design, but the total cost of ownership is significantly lower over time. We estimate the extra construction costs to be around \$22,383,000, but this is recouped with total savings of \$59,387,000 and an annual ROI of 6.75% over the 15-year period.

Conclusion

This study shows that ICS technology has obvious benefits, including the more reliable delivery of bags, fewer ramp incursions and savings due to the overall reduced cost of ownership.

Most of the advantages of ICS can be best realised only if there are changes in the way bag-rooms are managed. Traditionally, BHS operations are handled by each airline separately.

ICS works best in a common use environment where resource costs can be shared for baggage handling, check-in and operations and maintenance of the system.

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