Introduction

• MUC T2 started operating on 29 June 2003.

• First airport to install a BHS using CrisBag technology.

• Focus of this presentation: O.R. (operational readiness) programme for T2 BHS, not the technology. Convey scale and timescale of the O.R. programme.
Contents

• MUC BHS installations.
• Brief description of T2 BHS.
• O.R. programme, focusing on the BHS.
• Successes & shortcomings of the O.R. programme.
• Recommendations.

Terminal Buildings

• Linear Terminal 1, built mainly for originating & terminating passengers (predicted transfer throughput: up to 7%).
• Central Area, for passengers arriving by train, has shops & some check-in counters.
• Terminal 2 with centralised check-in, built for a large volume of transfer passengers (up to 53%).
BHS Installations

• Terminal 1, with check-in & reclaim.
• Central Area, with check-in.
• Building V3: stand-alone BHS for short connection transfer baggage.
• Terminal 2, with check-in & reclaim.
• Satellite, connected to T2 via 500 m tunnel.
Terminal 2 BHS

<table>
<thead>
<tr>
<th>Item</th>
<th>Terminal 2 &amp; Satellite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conveying technology</td>
<td>Totes</td>
</tr>
<tr>
<td>Total length</td>
<td>40 km</td>
</tr>
<tr>
<td>Conveying speed</td>
<td>1.8 to 7 m/s</td>
</tr>
<tr>
<td>Capacity</td>
<td>8,700 b/h departing</td>
</tr>
<tr>
<td></td>
<td>4,700 b/h terminating</td>
</tr>
<tr>
<td>Make-up positions</td>
<td>20 racetracks</td>
</tr>
<tr>
<td>Transfer in-feeds</td>
<td>10 (12 docks)</td>
</tr>
<tr>
<td>Terminating in-feeds</td>
<td>13</td>
</tr>
<tr>
<td>Check-in in-feeds</td>
<td>114 (+ 18 in C.A.)</td>
</tr>
<tr>
<td>OOG in-feeds</td>
<td>3 (+ 1 in C.A.) landside</td>
</tr>
<tr>
<td></td>
<td>3 airside</td>
</tr>
<tr>
<td>Reclaim racetracks</td>
<td>7 (total 560 m)</td>
</tr>
</tbody>
</table>

Check-in counter in-feeds
Self-service check-in with baggage

Kerbside check-in counters
OOG in-feed, Departure Level

Tote with bag
Problem Bag Area

Early Bag Store
Discharge to racetrack (make-up)

Empty tote stackers
OGG empty tote stacker.

BHS control room - Terminal desk & video wall
O.R. Programme - 1

Purpose of O.R. trials is to verify the readiness of the following as a whole:

- Facilities & systems.
  - Units, systems & interfaces already tested.
- SOPs.
- Staffing.
- Training, and familiarity with facilities.
O.R. Programme - 2

• Sept. 2002: Preparation of trial concept.
• 14.01.03 - 04.06.03: Execution of trials.
• 42 trials planned:
  – 38 Basic & Integrated.
  – 2 Night.
  – 2 Load (‘Stress’), 1 incl. emergency scenario.

O.R. Programme - 3

• Trials with ‘passengers’ and baggage.
• Every Tues. & Weds.
• 11:45 - 15:45 (20:30 - 00:00 Night Trials), excluding preparation, clearing up and debriefing.
• 2 waves of flights (STD 12:30 - 13:00 / 15:00 - 15:45), each with 5 - 7 flights.
O.R. Programme - 4

• 2,500 bags/trial (13,000 bags/load-trial).
• 6,000 filled bags available (3,500 from FMG, 2,500 from BHS contractor).
• 7,000 plastic sorting boxes borrowed from Deutsche Post to supplement real bags.
• 190 different trial events for baggage.

O.R. Programme - 5

• ‘Passengers’ check-in baggage.
• Also, helpers feed-in pre-tagged baggage via other check-in counters.
• Handlers feed-in pre-tagged transfer baggage via transfer in-feeds.
• Handlers feed-in pre-tagged terminating baggage.
O.R. Programme - 6

• DLH team dedicated for production of bag tags and BSMs for trials.

• Dedicated DLH representative with detailed knowledge of BSMs and DLH BSM tools, and with link to DCS dept. to expedite debugging of problems with BSMs and interface with DCS.

O.R. Programme - 7

The reality:

• Testing not completed when trials started.

• First installation of CrisBag technology, so BHS contractor & sub-contractors still learning.

• Not enough functional testing.
O.R. Programme - 8

- Not all IT equipment installed by start of trials (BHS control room, BIDS terminals, etc.).
- 44 trials actually conducted.
- 20 system tests were performed after trials ended (some in parallel to the last 2 trials).
- 2 real flights/day were made-up in T2 (check-in in T1) from 20.06.03.

O.R. Programme Successes - 1

- Identified some functional limitations.
- Partial substitute for insufficient testing:
  - Highlighted components (mechanical and control) requiring adjustment.
  - Highlighted some shortcomings in control of totes, enabling adjustments.
  - Highlighted software bugs in interfaces and BHS, enabling corrections.
O.R. Programme Successes - 2

• Identified some weaknesses in the scheme design.
• Provided information on real capacity.
• Identified some functional enhancements.
• Identified additional training needs.
• Increased familiarity with new facilities and equipment.

O.R. Programme Successes - 3

• Highlighted outstanding installation, rectification and commissioning.
• Provided impetus and expedited completion.
**O.R. Programme Shortcomings**

- Not all planned baggage trial events were covered (e.g. firearms, liquids).
- Better to have fewer bags in first few trials until confidence and familiarity are greater.
- Verification of functional performance not completed by the time trials started, and the relatively large amount of baggage per trial made verification onerous.

**Recommendations - 1**

- Trials are not a substitute for functional tests: they are complementary.
- Ensure that there is an extensive programme of witnessed, comprehensive functional tests.
- Ensure the functional tests proposed by the BHS contractor are approved by experienced operations personnel.
Recommendations - 2

- Ensure that the functional test programme is essentially complete prior to starting trials.

- Ensure unit tests, soak tests (‘bath-tub curve’ testing) and functional tests are included in the BHS schedule, and that adequate time has been allotted for them.

Recommendations - 3

As a very rough guideline, for a major BHS you should consider:

- at least 5 months of witnessed functional tests after completion of the BHS contractor’s unit tests.

- at least 5 months of O.R. trials after completion of functional testing.
Recommendations - 4

- Ensure that meetings and the method of raising and recording outstanding issues from trials are defined and agreed with all parties prior to trials.
- Ensure that a detailed protocol for recording baggage fed into the BHS and arriving at intermediate stations and delivery positions is prepared and disseminated prior to trials.

Some Design Recommendations - 1

- Have separate lines for empty totes: transporting empty and full totes on the same line can reduce capacity considerably.
- Ensure that the control system can change a tote’s destination while it is en route.
- Ensure that closed loops can discharge baggage, to avoid recirculation *ad infinitum*.
Some Design Recommendations - 2

• Have 2 SOOG lifts connecting the baggage hall to the check-in concourse, that can hold a loaded bulk cart or ULD and dolly (for contingency, but also useful during trials).

• Ensure that double-doorways between baggage hall and reclaim hall are large enough to allow the passage of a mini-tug and bulk cart, or ULD and dolly.
Bulk carts on check-in concourse (contingency)

Method of bringing trial bags to check-in concourse for trials