

# Developing a design for the new ticket offices at King's Cross Underground Station

Ian Rowe and Duncan Smith

*Rossmore Group  
Haseley Business Centre  
Warwick, CV35 7LU*

This paper discusses the development of human factors integration into the new ticket offices at King's Cross underground station. Including the examination of issues associated with compliance to many published standards, the engagement of a wide range of stakeholder groups and the operational and commercial needs of the company. Particular attention is paid to the primary research carried out in order to meet the objective of 'inclusive design' and therefore meet the requirements of the Disability Discrimination Act (DDA). This paper includes details of the original 'drivers' for carrying out the work, methodologies employed, results and conclusions.

The design work of the ticket offices is nearing completion and will shortly be in the process of being fabricated. As such this paper should be considered as a case study covering a completed project with a practical outcome.

## Introduction

The design development of the new King's Cross underground station is one of the first to incorporate the mandatory standard LUL-2-01018-003-A1 – Human Factors integration into system development. This standard was developed by London Underground (LU) as a response to the lessons learnt from the Jubilee Line extension project. This standard covers all areas within the station that are operated by LU staff including control rooms, tickets offices, etc. LU also specified that the design must be DDA compliant and be 'inclusive' in its approach.

## Motivations

London Underground introduced a new systems integration standard in 2001 entitled 'Human Factors Integration into System Design' that was introduced as a category 1 standard. The application of this standard is mandatory on all design whether it be new build or refurbishment of existing environments. Other drivers for the HF integration work included the Transport for London directive that states that all new design should be 'inclusive' in its nature and the statutory requirement of the DDA 1994. It was felt that in order to provide assurances to all stakeholders and compliance with regulation, an holistic approach would need to be taken that included high levels of engagement from all stakeholders including:

- Operations staff
- Union representatives
- LU managers
- Disabled customers
- Able bodied customers
- Equipment suppliers/maintainers

## Methods

The methods used to ensure that Human Factors considerations were integrated into the design of the new ticket office are set out below. All methods were fully documented to provide the

necessary assurance for regulatory bodies such as HMRI and compliance with London Underground's own standards.

## Literature search

Various publications were reviewed to establish available standards and to ensure that published information based on previous experience was taken into account. The documents that were considered appropriate and reviewed along with a summary of their contents are included in Table 1 below. Particular attention was given to the height of the serving counter both on the customer side and the employee side. This was of critical importance to make the 'reasonable adjustments' required by the DDA. It can be seen that the guidance is disparate and as such it was necessary to conduct primary research to test usability of different counter heights with a broad population of both able bodied and disabled users.

**Table 1. Summary of guidance**

Standard or guidance	Summary of information
BS8300	General counter heights for wheelchairs users should be 760mm. Tickets may be purchased at an extended reach of 1170mm.
SRA Train and station services for disabled passengers. A code of practice.	Ticket counters should be 760mm. Shared kitchen areas – Worktop height 850mm. Café table height 800mm. Parking meters must not have operable parts above 1200mm. Lift control buttons should be between 900 and 1100mm.

Conclusions drawn from this review are as follows:

- Whilst 760mm is a common height within both publications, the SRA guidance specifies kitchen worktops and café table heights higher than that of a ticket counter. (Generally task duration and complexity is greater in the case of the latter – see task analysis results.)
- Operable parts for parking meters in the SRA guidance is outside the extended reach specified in BS8300.
- BS8300 suggests that purchasing tickets could be performed at an increased height due to the short duration expected in transaction time and the infrequency of the task.

## Research of existing environments

As part of a standard methodology, research was conducted into existing operational environments to understand how these are operated, what works well and what does not. Site visits during normal operating times were organised to a total of three existing LU ticket offices and two mainline ticket offices. During the site visits interviews with operations staff and customers were conducted and digital stills/video footage taken.

### *Observations – existing LU ticket office, Jubilee Line Extension*

The Jubilee Line ticket office visited is considered to be the new LU 'standard' and features an 'open plan' approach. This uses large glass panels and modern feel brushed steel and blue glass sign frieze. Results from this visit are summarised as follows:

- The design works fairly well in general.
- The design had been the subject of a 'mock up' and as a result the equipment was reasonably placed and fitted adequately.
- There was adequate space for performing all tasks including paperwork, etc.
- The cross glass communication performance was felt to be poor.

### *Observations – refurbished ticket office 1, Piccadilly Line*

This ticket office had been recently redeveloped using the new ‘open plan’ approach as per the Jubilee Line office. However, due to changes that have been made in the way that these offices perform their accounting function and the discontinuation of certain pieces of equipment, operators felt less happy with the performance of the system. Results from this visit are summarised as follows:

- The design does not work well with the revised machine specifications (keyboard too large for space allocated, ticket issuing machine position causes difficulty for operator).
- Redeveloped cash tray generally configured in a non-preferred way.
- The cross glass communication performance was felt to be poor.

### *Observations – refurbished ticket office 2, Piccadilly Line*

This ticket office had been recently redeveloped using the new ‘open plan’ approach as per the previous environments. In this case, however, the operators had decided to make physical modifications to the layout and furniture in order to make their working environment more comfortable and efficient. The results of the visit are summarised as follows:

- Counter height is too low – only suitable for seated operation.
- Equipment does not fit onto the work surfaces (as a result users have fabricated additional surfaces to lay over the original ones in order to increase capacity).
- The cross glass communication performance was felt to be poor.
- There is no facility for the housing of the regularly used fares chart and other paperwork.

### *Observations – mainline ticket office, Chesterfield Station*

A group representing the disabled community as a ‘best practice’ example identified this ticket office. The design featured a dual height counter at one counter position and way finding tactile flooring for use by visually impaired persons. Both operators and customers were interviewed. The results are summarised as follows:

- The low counter is never used.
- The regular wheelchair users interviewed prefer to use the standard height counter because:
- They are able to reach and perform the ticket purchasing function relatively easily.
- They do not like drawing attention to their disability by waiting for the low counter to be free.
- The low counter does not work well with the ‘Disney’ queuing system.
- Operationally the low counter needs to be manned all the time. (A seated only operator position.)

### *Observations – mainline ticket office, Liverpool Central*

This ticket office features an adjustable height counter. The visit is summarised as follows:

- The height adjustability is appropriate for configuring the height for maximum comfort of the operator.
- The height adjustment process takes a finite time and is felt inappropriate for customers since the adjustment time is a significant proportion of the transaction time. I.e. Customers do not want to wait for the counter height to be adjusted delaying the start of their transaction for 10 seconds, when the normal transaction time is normally less than 20 seconds.
- Operators do not use the height adjustment facility for convenience of customers.

## **Existing environment research conclusions**

From the research into existing ticket office environments the following conclusions were reached:

- The design of all environments researched had lacked user input and as a result all had major opportunities for improvement.
- There was little evidence that lessons had been learned from the earlier developments and considered for newer designs.
- Efforts made in the design to accommodate wheelchair users were not used in practice.

## **Process mapping and task analysis**

Having established that it would be necessary to conduct fitting trials a task analysis would be required prior to the commencement of the fitting trial. In order to understand the nature of the tasks being performed a process mapping exercise was conducted.

### **Process mapping**

A total of 17 operations staff were involved in defining the processes that occur in the ticket office. This exercise enabled the consultants to gain a good understanding of all processes conducted and enabled the operations staff to map and discuss the processes. This exercise also encouraged a dialogue between different operations staff and highlighted the slight differences in the way staff undertake their tasks. A total of 12 high level processes were identified.

### **Task analysis**

Video footage was taken at three different ticket office locations during normal operating times. From this careful analysis was conducted of tasks and movement. This analysis identified a hierarchy of the most frequently used equipment and how other reference materials were used. e.g. timetables, fares, etc. On the customer side the tasks and behaviours of customers were also analysed. It was established that the average transaction time for ticket purchase is 17 seconds.

### **Anthropometrics analysis**

The anthropometrics data for 5th percentile females to 95th percentile males (UK) were overlaid on a scaled layout diagram and zones of convenient reach identified and mapped. This was performed for both seating and standing operator positions.

### **Fitting trials**

A full size mock up was manufactured from MDF and Perspex in order to perform fitting trials for both operators and customers.

The counter height on this was made adjustable using commercially available car jacks such that satisfaction rating could be obtained by the same users but with different counter heights.

Fitting trials were conducted at a London Underground office near to the operating environment at King's Cross station (for operators and able bodied customers) and subsequently the mock up was moved to the spinal injuries unit at Stoke Mandeville Hospital where wheelchair users were invited to take part in the trial as customers. The actual equipment that will be used in the final design was used during the trial. Future technology such as 'oyster card' swipes were also employed during the trial.

## **Results**

### *Operators*

17 operators were engaged in the trial and overall a satisfaction rating of 94% was achieved at counter heights of 950mm. This allows both comfortable standing or seating serving position.

Equipment positioning was reviewed and included the ability for operators to change all equipment positioning during the trial. From this a 'best' fit layout was derived with various pieces of equipment employed in different positions at the workstation dependent on operator choice.

### *Able bodied customers*

A total of 40 able-bodied customers were engaged in the trial. From these 100% satisfaction levels were recorded with a counter height of between 760mm and 1000mm.

### *Disabled customers*

A total of 19 wheelchair users agreed to take part in the trial. All of these subjects had spinal injuries and a number had other disabilities in relation to the use of their arms and hands. From the sample 95% of the users reported high usability for the recommended counter height of 950mm.

### *Acoustic trials*

In all visits to existing LU ticket offices, the performance of cross glass communication was identified as a major opportunity for improvement. Acoustic analysis was conducted at the existing King's Cross ticket office in order to establish the performance of the system. The mock up was then used to trial alternative microphone and speaker positioning and new technology used to provide enhancement of system performance.

## **Conclusions from fitting trials**

There is no published standard covering recommended heights for disabled users other than those in wheelchairs. To this end it is felt likely that users with other muscular-skeletal conditions affecting the back and spine and those with sight impairment would find the traditional disabled counter height of 760mm uncomfortable to use. This part of the population as a group is many times greater than populations of wheelchair users. Making a single counter height that can be used by the majority of the population has the following advantages:

- Preferred by majority of users.
- Satisfies 'inclusivity' requirement by not discriminating against any user group.
- Operationally more efficient.

## **Overall conclusions**

In conclusion this study has, in certain respects, challenged the standard and guidance available and has indicated that an alternative strategy that takes into consideration the requirements of the wider population in a truly inclusive manner as well as the operational and commercial requirements of London Underground and the usability of the design by the staff, has been achieved.

## **Integration into system design**

All elements of the research carried out were fully documented and presented to representatives of all stakeholder groups. Comments were collected from these groups and the final report was issued with recommendations to the designers such that the final design will include the results from the integration work.

## **Application review**

A review of the final design will be performed at some time after this ticket office design is commissioned in 2007. This will include further operator and users engagement that will serve as a conduit to feedback and understand how effective the integration process has been.