THE HUMAN FACTORS OF LONDON UNDERGROUND FIT FOR THE FUTURE STATIONS

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Fit for the Future Stations (FfFS) is a programme to bring about fundamental changes in the way London Underground (LU) stations are staffed and managed. A key aspect of this will be making staff more visible and accessible to customers, by bringing them out from back offices and ticket offices and into the ticket hall areas. Furthermore staff will be equipped with more up to date technology, in particular mobile devices such as tablets to support them in providing improved and more contemporary customer service. Supporting these changes to the way customer service is delivered within LU stations will be a range of new customer information related facilities. These include a Staff Seat which is being trialled as a seat primarily intended for occasional use by staff, to be located within clearly demarcated information zones, Visitor Centres (VCs) and Customer Receptions. This paper describes some of the Human Factors activities and considerations which have been involved in the design of these new facilities relating to the FfFS programme.

Introduction

London Underground (LU) as part of the wider Transport for London (TfL) is introducing a fundamental transformation of the way customer service is provided within LU stations. This will be brought about by a programme of change known as Fit for the Future Stations (FfFS). The transformation in customer service will have at its core moving staff out of back office areas and ticket offices thereby increasing the availability of staff in the public areas of stations, primarily in the ticket hall, in order to provide information, ticketing assistance and general assistance to customers. Detailed information regarding TfL’s FfFS programme is provided in ‘Fit for the Future Stations, Our refined proposal’ TfL, May 2014 (TFL, 2014).

The changes being introduced by FfFS will include enhancements to station ambience, such as new lighting designs and features, a new staff uniform, the use of mobile devices such as tablets by staff for the provision of information to customers and a number of new facilities being introduced to the built environment. There has been Human Factors (HF) input into all elements of FfFS however this paper will focus on HF involvement in the built environment aspects of FfFS.
The FftFS programme includes multiple projects one of which is FftFS Built Environment (FftFS BE). The built environment project is focused on changes to the physical infrastructure of stations in order to support the changes in staff roles and customer service being introduced by FftFS. The majority of the built environment changes are in relation to customer facing aspects of the stations. These changes include new station lighting concepts and principles, which emphasise less uniform, more creative station lighting schemes and a set of new features within stations including highly visible well demarcated zones for information and ticketing. The new features being introduced to create information and ticketing zones will comply with a common design language known as the ‘station design idiom’. The station design idiom has been developed by TfL, working with 3rd party architects and industrial designers. The idiom emphasises circular forms as the underpinning design theme, drawing from the iconic LU Roundel.

This paper presents 3 of the key new facilities being introduced by FftFS BE. These are the Staff Seat, the Customer Reception and the Visitor Centres (VCs). All of these new facilities involved significant HF input into the design.

**Staff Seat**

The Staff Seat is a facility being considered primarily for staff to use for brief periods of time in order to rest whilst still remaining within the public areas of the station and therefore available to assist customers. In most cases there will only be one Staff Seat per ticket hall. The Staff Seat is a novel concept and it has not yet been confirmed if this facility will be introduced throughout the LU network. Initially it is only being introduced on a trial basis at a limited number of locations.

The proposed Staff Seats will be located on the unpaid side of the gateline near to clearly demarcated customer information zones, see figure 1 below:
The Staff Seat design went through an evolution of design concept as illustrated in figure 2:

Initially it was believed the Staff Seat should be attached to the wall and could be flipped down as and when required and that it might be lockable by key. However as a result of optioneering this concept was eventually rejected in favour of a raised height, sit-stand ‘bar stool’ style design, which would be located close to the wall and fixed to the floor.

**Human Factors aspects of the design**

There was extensive HF input into the design process of the Staff Seat. This included the use of anthropometric data from PeopleSize anthropometric software package and guidance on the ergonomics of seat design drawn from EN ISO 9241 Part 5 (ISO, 1988)

The HF input for the design of the seat was informed by the anticipated context of use of the seat and the requirements for the seat.
The following table presents the requirements which had an impact on the HF design and summarise what the impact was:

<table>
<thead>
<tr>
<th>Requirement description</th>
<th>HF design impact</th>
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<tbody>
<tr>
<td>The staff member must look approachable when located in the seat, i.e. avoid perceptions of off-duty resting spot for staff or area of inactivity</td>
<td>Seat needs to be a raised height, sit-stand, ‘bar stool’ style seat in order for staff to be adequately visible to customers and not appear to be off-duty</td>
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<tr>
<td>Staff will carry out some basic administrative tasks using their mobile devices at the seat</td>
<td>It needs to be possible to use a mobile device while sitting on the seat. This may mean that staff may need to be able to rest a mobile device such as a tablet device on their laps in order to facilitate two handed use of the device for typing</td>
</tr>
<tr>
<td>The seat must have adjustable height and be comfortable to sit on for the range of staff users</td>
<td>A height adjustability mechanism needs to be provided. It should be such that the height of the seat can be adjusted with relative ease by staff to adjust the height from a height suitable for a range of users from the 5th percentile female in stature through to the 95th percentile male.</td>
</tr>
<tr>
<td>The seat will be based in the customer information zone, ideally with good sightline of the ticket machines and gate line areas</td>
<td>In order to provide good sightlines the seat needs to be a raised height (sit-stand) style seat</td>
</tr>
</tbody>
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The author worked closely with Industrial designers (Jedco Product Design) to design a seat that would be suitable for its intended purposes and also ergonomically acceptable for the widest practicable range of staff.

The ergonomics considerations for the seat design included determining the seat height adjustability range, the footrest height and the seat pan design, including shape, profile and dimensions of the seat pan.

**Seat height range**

It was determined that for a sit-stand style seat the range of height adjustability of the seat pan should be from 660mm to 760mm above Finished Floor Level (FFL).

The minimum height of the seat pan was determined based on the gluteal fold (the crease just below the buttocks) height when standing of the 5th percentile female.

The seat height maximum was determined primarily by comparison with commercially available sit-stand style seats which indicated that such seats
frequently have a maximum height of approximately 760 mm. This maximum height provides an acceptable seat height for taller staff and provides a reasonable limit to the range of height adjustability of the seat.

**Footrest height**
The footrest is set at a fixed height of 250mm above FFL. Anthropometric data indicated this height would allow the widest practicable range of users (5th percentile female through to 95th percentile male in stature) to be able to sit on the seat with their thighs at close to horizontal if the seat pan height is appropriately adjusted. In addition to facilitating a comfortable posture, a footrest to seat pan relative height which facilitates a near horizontal posture of the upper legs also enables staff to use a mobile device such as a tablet as they are then able to rest the tablet on their lap to allow for 2 handed operation of the tablet.

**Seat pan design**
The seat pan design included the shape of the seat pan, to provide a comfortable, aesthetically appealing design which is consistent with the Station Design Idiom. The dimensions of the seat pan were also an important factor in order to provide a seat pan which is suitable for the widest practicable range of staff. The seat pan dimensions were derived from a combination of comparison of commercially available sit-stand style seats and the application of anthropometric data. The dimensions of the seat pan also attempted to achieve a balance between a seat pan which is large enough for larger staff, while not being too large that smaller staff find that it fails to provide any sense of sitting securely within the seat.

Two seat pan prototypes were produced from high density foam for initial comparison. A smaller seat pan which had an inner surface width of 460mm at its widest point and a larger seat pan which had a width of 525mm at its widest point. The 525mm wide seat was based on the sitting hip width of the 95th percentile British female with an additional allowance for winter clothing.

Early user trials indicated that the smaller seat pan was found to be as comfortable or more comfortable than the larger seat pan. Also the larger seat pan was not found to provide as much sense of sitting securely within the seat. Furthermore comparison with commercially available products indicated that such seat pans generally have a width of 350 to 400mm, so even the smaller 460mm width seat is larger than most commercially available products. Both seat pan sizes have been used for production of Staff Seat prototypes however the smaller seat pan size has been chosen for the first set of station based user trials.

**Seat pan shape**
The seat pan shape was based on the need to conform to the Station Design Idiom which emphasises circular forms, comparison with seat pan shapes of commercially available products and refinement of the seat pan profile based on modifying the high density foam prototypes.
It was determined that the base of the seat pan should be flat with the sides and back curving up so as to provide a sense of sitting securely within the seat pan. The back of the seat pan provides a sense of some minimal degree of lumbar support to some users, however it should be emphasised that the seat is intended only for occasional use and for short periods of time and consequently the need for full lumbar support provision is not required and would not be practicable in the context of such a seat.

Figure 3: Proposed Staff Seat showing the shape of the seat pan

A limited number of seat prototypes have been manufactured and these will be subject to a series of user trials at a number of stations. The feedback from the user trials will be used to modify the seat design if necessary before the Staff Seat is considered for roll out more widely across the LU network.

Customer Reception
At some of the busier central London stations there will be a ‘Customer Reception’ facility provided. This will consist of a small stand alone reception table within a clearly demarcated information zone with the Staff Seat in close proximity. The facility will be staffed at all times during busy periods, however when not staffed it will provide the appearance of an information facility which is available for use for customers. While the Staff Seat will be nearby it is intended that staff will be standing when assisting customers at the Customer Reception and that the seat will only be used for resting during quieter periods. The customer reception design concept went through the design evolution depicted in Figure 4:
As a result of the optioneering process, informed by the anticipated context of use, it was determined that the Customer Reception facility should be a small, circular table placed at a height which would be suitable for use from a standing position. The table top will slope to a sufficient degree that coffee cups cannot be placed on it. It will have 2 small pegs at the lower end of the table surface on which a tablet device can be rested. The table will also have two slots for the placement of information leaflets. Figure 5 presents a design drawing of the Customer Reception table.

The Customer Reception table will be used both by staff and customers. It will be a shared space for staff to provide customers with information. Staff may rest their tablet device on the table top and use this to share journey planning information with the customer. Alternatively staff may use the table to share information with customers from leaflets provided within the information zone. The table top will have some form of information embedded within it. This may be the tube map, however the table will have a removable, hardened and scratch
resistant glass surface. This will enable the information provided on the table top surface to be changed, for instance it could be changed during special events, to include information relevant to the event.

HF input into the design of the Customer Reception table included determining the height the table top should be set at in order to ensure it is at a comfortable height to be used in a standing position by the greatest practicable range of users and the angle the table top should be sloped at in order to ensure that it will be a suitable angle on which to rest tablet devices while providing information to customers.

It was determined, partly based on guidance from ISO 9241 Part 5 that the centre of the table top should be 1m above FFL. It was also determined that the table top should be sloped at an angle of 22° from the horizontal.

As with the Staff Seat, the Customer Reception table prototypes will be subjected to user trials at a number of stations and any feedback from the trials will be used to modify the design if necessary.

Visitor Centres (VCs)
Visitor Centres (VCs) are being established at some of the major LU gateway stations, such as King’s Cross, Euston, Liverpool Street, Heathrow Terminal 123 and Victoria. The VC at King’s Cross station (see figure 6) was brought into use in April 2015, while, the other VCs are still in development.

The VCs are primarily aimed at infrequent visitors to London, such as tourists and will provide travel, tourist and ticketing information to customers. They will also provide a ticketing service including third party tourist tickets and TfL related ticketing including Oyster Cards, Emirates airline cable car and River Services.

The VCs will replace the former Transport Information Centres (TICs), which had an outdated, traditional, utilitarian appearance and in which the service agents were screened off from the customers. The VCs adopt a more contemporary, retail style approach to customer service, with the incorporation of more design flair. This includes the elimination of the screened barrier between customers and service agents and provides more of a sense of a shared space between customers and staff.

Colour coding has been incorporated into the design, using the TfL colour set, which has been combined with symbols to represent different modes of transport.
Significant HF input was included in the design of the counter positions. Factors considered in the design included determining the optimal height of the counter that would be suitable for both customers and staff, positioning of the receipt printer and ticket printer, with regard to the reach from a sitting position and standing position, the width required for each counter position, the width required for adequate leg room below the counter, the position of the LCD screen used for ticketing, the position of the “Oyster validator” and the design of storage slots for Oyster cards and leaflets.

Figure 7 is a 3D drawing of the design of an individual counter position for King’s Cross VC.

A prototype VC counter was developed from the initial designs and this was used in order to evaluate the design from an ergonomic perspective and to
facilitate staff engagement. This enabled the design to be refined and a number of changes were made as a result of the assessment of the prototype counter position.

The counter position design was finalised based on the output of the assessment of the prototype and these counters are in use in the King’s Cross VC. The same counter design will be used at all the other VCs.

**Conclusion**

The FitFS programme will bring about a fundamental transformation in how customer service is provided at LU stations. This transformation will be underpinned by a number of built environment elements. There has been significant involvement of LU HF in the FitFS programme including the built environments aspects. This paper has focused on 3 of the built environment features. These are the Staff Seat, the Customer Reception facility and the Visitor Centres (VCs). The HF input has had a real impact on the design and will help to ensure that the facilities being introduced will be fit for purpose for staff and customers in order to support the new approach to customer service which is at the core of FitFS. As such the HF input will have a positive impact on both the staff and customer experience.

Next steps will include continuing HF support to built environment changes in addition to increasing HF support to the introduction of mobile devices such as tablets for staff use in stations, both to assist customers and also to perform various operational and administrative tasks which previously would have been performed either through paper based methods or on desktop PCs within back offices.

**References**


BS EN ISO 9241 Part 5 1998, *Workstation Layout and Postural requirements*