In a close-fitting Tube tunnel, it is hard to provide external assistance - which puts the role of on-board staff into perspective. A Central Line train of 1992 Tube stock at Liverpool Street. Paul Bigland

Driverless Underground trains for London?

The possibilities are considered by M.A.C. Horne FCILT MIRO, Director, Fifth Dimension Associates Ltd

On a particular January Sunday, an ordinary-looking London Underground train did something not seen before. Scrutinised by Ministry of Transport officials, it ran between Chigwell and Grange Hill via Hainault, with nobody touching the controls (including doors opening and closing). At Hainault, the train waited for the signal to clear (at what was now the back), whereupon the doors closed and the train accelerated out of the station, having reversed direction; the doors opened automatically again at Grange Hill. This was the culmination of several years' development from an under-funded team, breathing life into the Engineering Director's aspiration to run driverless trains on the Underground. This was in 1980. It is now 2012 and we are still talking about it. What is going on?

Not very much, at least not in London. The original development was termed the 'Fully Automatically Controlled Trains' project, producing the convenient acronym FACT. The experiments were successful as far as they got, but the technical issues were formidable, and, with the House of Lords funding hiatus and red-tinged political minders arriving at County Hall, there were other battles to fight. FACT development going very public coincided with the height of union difficulties about proposed one-person operation (OPO) on the Hammersmith & City Line; one might draw conclusions from that. OPO was eventually delivered throughout the network and FACT was dropped.

If TfL were building an entirely new railway, uncontaminated by past practice, then it would surely be completely automatic and more thinly manned than today's lines. The technology is there to do it, and systems can be duplicated to provide very high levels of reliability. Passengers can be physically separated from the track with platform edge doors. Escape routes can be provided in larger tunnels with walkways. Good communications links will be in place, and trains could even be driven remotely. Staff and passenger culture can be created from new. Moreover it is do-able, and can be seen to work elsewhere in the world.

Unfortunately, this is not the happy position in which TfL finds itself. It wants the benefits, but can only offer a system that is old and congested, not easily adaptable and has historic and cultural baggage that will take a huge battle of wills and serious money to alter.

FACT

We need to look at why TfL is currently entertaining the prospect of 'no hands' operation, but first we need to define some terms. The lines concerned are those deep Tubes soon due for upgrade, with what London Underground calls Automatic Train Operation (ATO): this means that all the driving is automatic, but there is an train operator on board who controls the doors from a driving cab at the leading end. We can extend this mode of operation, using technology to open the doors automatically and to use a roving operator to close them. I shall term this mode 'Roving ATO' (and this can be seen on the Docklands Light Railway). Fully hands-off operation is then possible where the train runs completely automatically, including door control (I'll call this FACT to maintain association with the 1980 proposals). There are two flavours of this: FACT with somebody on board 'just in case' or 'for reassurance', and FACT where there are no staff on board at all. I shall term these FACT+1 and FACT+0 respectively.

Under FACT+0, railway operators will note that many complications go away. It provides unprecedented opportunities to introduce demand-led instantaneous scheduling that can be finely tuned to meet the various expected peaks and troughs in the service, and even demand that can appear at very short notice. The service controller presses a button and more trains come into service, just like that. The technology to do this already exists, and the benefits are significant, especially where a

disrupted train service can be corrected almost immediately. It also has the advantage of quicker turnaround times and minimal time wasted at stations, which can save trains.

These advantages are far harder to achieve on a staffed system because sitting behind every working timetable are duty schedules for all the staff involved ('diagrams' in main line speak). One cannot simply put unplanned trains into service: the extra staff have to be there. Their reliefs have to be planned ahead. Staff have definite hours of duty, and expectations of a break near the middle of the period. It is accepted that staff should be treated this way, but clearly it is a constraint to flexibility of operation. The cost of the train staff payroll is very high, as is all the scheduling and management resource that is required. Readers can see why a FACT+0 solution might appear attractive.

Moreover, looking back into history, we see that Underground drivers were once practically engineers as well. They had both to drive the trains and when something went wrong they were pretty much expected to fix it; of course they then had access to all the equipment. We have since seen equipment disappear from view so it cannot be got at. We have seen it become more reliable, so lack of familiarity with failure becomes a huge problem. We have seen trains become more complicated. We have seen automation, with the driver's job now done by electronics whilst the person in the cab has become a traditional guard. From the perspective of those footing the bill, the inescapable conclusion is that they are paying more and more to get less and less.

Driverless Tubes in service by 1990

Standard Reporter

UNDERGROUND trains without drivers or guards will be running on the London Tube system by 1990.

First line to have the new unmanned service will be the Central. It will be smoother, faster, safer and more reliable than the present service.

Before then however, driverless trains will be tried on the East London line between Whitechapel and New Cross, and the section of the Central Line between Hainault and Woodford.

By the year 2010, almost the entire London Transport Tube network will have been turned over to fully automatic trains.

These are the firm forecasts today of London Transport's top engineer Mr William Maxwell, member of London Transport executive, responsible for engineering.

The introduction of the no-man trains will open the way for the gradual reduction of at least 3000 Underground workers—mainly drivers.

Mr Maxwell has been spreading the gospel of the driverless train throughout the country in the past few weeks. It is the main theme of his annual speech as chairman of the engineering section of the Institution of Mechanical Engineers.

A cutting from the Evening Standard, 4 October 1977.

Tolerance

With ever more intense and heavily used services, and ever more reliable equipment, when something does go wrong, are we beginning to ask too much of the operator? The system is becoming increasingly less tolerant of failure and it may be a good time to review the responsibilities of everyone who might get involved. It is a huge responsibility to find oneself alone on a train presiding over what could either be a minor, easily fixable occurrence, but where a missed symptom, unremembered procedure or just bad luck suddenly precipitates a major incident; there have been several recently which reinforce this suspicion. This is no reflection on the majority of staff, it is a systems problem

Passengers look for space inside a busy Jubilee Line train of 1996 Tube stock at Green Park. Paul Bigland

that is also being faced in other industries, and perhaps the airline industry would suggest a comparison.

Even very reliable equipment is still not failure-free, and secondary failures can mask the symptoms of the first, with unfortunate results for the inexperienced. Traditionally, system operators devise additional processes and training to overcome apparent systems failure, which is expensive, inefficient and may not even work, especially when something really unusual happens. The outcome is ever more training for ever less frequent eventualities, pushing costs up, without necessarily the confidence that when something does go wrong all will be well. The consequences of a suboptimal response on a (frankly) overcrowded network could be very serious. Is an expensively-trained train operator in the driving cab the best solution to handling rare but inevitable failures? I don't think anyone has an answer, but I do understand why the question is being asked.

Activities

The (automatic) train operator today has several functions:

- Opens the doors if it is safe to do so;
- Closes the doors at the optimal moment;
- So far as practicable, checks that the doors are closed, that nobody outside the train is trapped and that it is safe to proceed, and having done so operates the start buttons;
- Maintains vigilance throughout journey and is ready to stop train if circumstances call for it;
- Gives information to passengers if the train is delayed;
- If there is a minor failure, deals with it and passes accurate information to control;
- If there is a major failure or incident, passes accurate information, and assists where help must come from outside;
- As the on-site 'representative of last resort', in the event of a devastating emergency, to use initiative to detrain passengers or take other action where the urgency warrants it (for example a terrorism event).

A quick review of these activities indicates that some can reasonably be automated, or do not have to be initiated from the train. But automation can't really help when multiple misfortunes strike, or events occur that are so unusual it is not feasible to plan for them.

We know it is technically possible to arrange the doors to open automatically after basic checks have been undertaken, and that station staff can inhibit opening if necessary, for example if a platform is closed. In either FACT scenario there seems to be no reason why door operation and the required safety checks could not be managed by platform-based staff, and there are practical advantages to doing so. Platform-based staff can more easily check an apparently open door or anything that looks unsafe, and maintain a lookout more easily than someone incarcerated in a cab at one end of a train. Timed door closures or operation using CCTV from the control room might also feature where traffic is quiet.

On the Roving ATO model, our door operator would be inside the carriage. This approach works well on a system like the Docklands Light Railway (DLR), where the door operator is styled 'train captain' and clothed in bright blue to maximise visibility and provide a reassuring presence. The model is sufficiently beguiling for others to follow, perhaps on London Overground and some other main line train operators (though not with ATO).

Packed

But let us look at the Overground, or those parts that use 2-person crews. The on-board Customer Service Assistants (who I call guards) do indeed

control the doors from within the passenger compartment, like the DLR, but only when it is quiet. When busy, they retreat to the rear driving cab and control the doors from there. We might reasonably infer from this that it is simply not practicable to control anything from a passenger compartment that is packed solid - which on some sections of this very successful railway it is.

Now the 'big railway' has spacious passenger compartments, and even they get full. Translate this to a packed Tube stock car: let us contemplate the southbound Piccadilly Line in the morning peak at (say) King's Cross. I suspect I am not alone in wondering how the 'captain' would even shift across the car to operate the doors at the next stop, let alone control people attempting to board through the local 5ft doorway as a lookout is maintained. Is it even possible to monitor a platform from the centre of such a scrimmage? If the 'captain' can be anywhere on the train, how do we provide adequate CCTV or other safety information that surely needs to be communicated? Retreating to the rear cab might be an option, but Mayor Boris Johnson has said that he doesn't want train cabs to be provided at all.

All this seems to make the case for managing train despatch from the platform, at least when it is busy (though some sections of line always seem busy these days). Platform despatch does leave the question about what a train captain might actually do.

At this point one gets interested in the costs saved by eliminating drivers (to produce what Mayor Boris calls 'driverless trains'). If train operators merely become train captains or platform despatch staff, or both, one might be circumspect about where the savings arise. There's a lot more work to do (some done in 1980, by the way).

There is another challenge where doors are manually controlled from a random passenger doorway: it takes longer. Under the Docklands Light Railway model the 'captain' assumes a vigil at an ordinary doorway, closes all the other doors, notes when the 'doors closed' visual indication is given, checks everyone is clear and then closes the local door before the train can start. My own reckoning suggests this adds about 5 seconds to every station stop. This sounds trifling, but on a line like the Piccadilly, journeys might include 42 station stops; this adds 420 seconds per round trip. On a 2-minute frequency that means an extra 3–4 trains are needed and there is the risk of reducing valuable line capacity as well. There is also the social cost of increasing journey time.

Emergency

Finally, there is the emergency to consider. We must not forget that once a train is committed to what, in effect, is a large, closely-fitting iron pipe, then it is a lot harder to provide external assistance.

At present the operator is in the leading cab, well positioned to see what is happening ahead, with good access to controls and equipment displays and, if necessary, the ability to get out of the train to inspect something in front. He can communicate with the service controller in private (and this can be a definite advantage in a developing situation). Without a cab we could have the 'captain' effectively trapped anywhere in a very crowded train without having much more than a radio blaring not necessarily reassuring messages to all and sundry. It is hard to move about, so where on the train will there be some kind of supervisory position from which facts can be gleaned and control assumed? Is it possible to manage what can potentially be extremely stressful and demanding situations like this (imagine it on an aircraft)? Personally I'm not certain that a cab-less train would not create overwhelming complications given the type of system we have, irrespective of mode of operation. Where delays happen, they would surely take longer to address?

It is very hard to believe that ATO-type operation should (or can) carry on unchanged for ever. But the present 'driverless' suggestions seem to have some ideological base that could be misplaced. The DLR-type train captain concept was conceived in a time where trains were one carriage, rarely 'crowded', operated in open air and where the captain was always visible and could easily take over the controls, at the front. This is about as far removed as one can get from a heavily used Piccadilly Line train where, in a crowd, only a few people will even be able to see the 'captain' and it could take maybe 10 minutes to struggle from one end to the other.

By the way, Bob Bayman (operations manager of the Docklands Light Railway during its design and opening stages) pointed out recently that the safety authority required staff-supervised door operation on the DLR, and it was only because there were fewer trains than platforms that the 'captain' was on the train at all.

The main benefit of FACT+0 operation is the fantastic flexibility that it offers to improve the resilience of the train service, but Boris Johnson has said that all trains will continue to be manned, thereby, at a stroke, requiring retention of all the scheduling and management paraphernalia that we have now, and all the constraints that flow from it. So, are we simply looking at posturing supported by some technical trials in order to provide a veneer of credibility, perhaps like the FACT trials in 1980? If not, then there still appears to be a lot of thinking to do. mr

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