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Elizabeth line Joint Trial Operations Lessons Learnt

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Learning Legacy Document

1. Introduction

1.1 Purpose

The purpose of this report is to identify the key lessons learnt during the planning, implementation and close-out of the Joint Trial Operations (JTO) Programme of the Elizabeth line. This report documents the lessons learned in the overall planning and delivery of the programme, rather than detailed operational lessons learned from individual exercises. For an account of the progress of Phases 1 and 2 of the programme and operational lessons learned, see the Joint Trial Operations Close-out Report (RfLI-OPS-OP-PLN-0019) and Joint Trial Operations Case Studies:

Case Study Title	Document No.
Passenger Incidents	RfLI-OPS-OP-REP-0056
Infrastructure Defects	RfLI-OPS-OP-REP-0059
Train Rescue	RfLI-OPS-OP-REP-0058
Controlled Evacuations	RfLI-OPS-OP-REP-0057
Emergency Services	RfLI-OPS-OP-REP-0060

1.2 Scope

1.2.1 In scope for this document

The scope of this document is to identify the lessons learnt with regards to the planning, implementation, and close-out of the Elizabeth line Joint Trial Operations Programme only.

1.2.2 Out of scope for this document

Individual stakeholder Trial Operations programmes, individual exercises, and exercises that took place after the conclusion of the Joint Trial Operations Programme are not within the scope of this report.

1.3 Who should read this document?

The target audience of this report includes any stakeholders owning, leading, managing, planning or delivering large-scale, complex operational readiness programmes, particularly in the railway and broader civil infrastructure context.

1.4 Document review and update

It is not anticipated that this document will be reviewed or updated after its initial publication; it is a standalone report framing a specific point in time.

1.5 Other relevant documents

1.5.1 Joint Trial Operations Plan (JTOP) and Joint Trial Operations Execution Plan (JTOEP)

The Joint Trial Operations Plan is a document that represented the overarching strategic level concept of how the JTO team planned, implemented, and assured the Joint Trial Operations Programme of exercises. This document set out the proving objectives and success criteria for the Programme as a whole and outlined how this would be achieved.

The Joint Trial Operations Execution Plan is a document that represented the detailed, tactical level methodology of how the JTO team intended to plan, implement, and assure the Joint Trial Operations Programme of exercises. This document focussed on the detail of how Earned Value was conceptualised, as well as how it would be calculated and tracked as the programme progressed.

These two core documents would allow initial framing of the Lessons Learnt process of the Joint Trial Operations Programme against their baseline objectives and should be used in conjunction with the documents and discussion below.

1.5.2 Joint Trial Operations Case Studies

A series of Case Studies into broad topic areas were conducted immediately following the conclusion of the Joint Trial Operations Programme by RfLI's Exercise Planning Managers, and these focussed on:

- Controlled evacuations,
- Exercises involving the Emergency Services,
- Infrastructure defects,
- Passenger incidents, and
- Train rescues.

1.5.3 Joint Trial Operations Close-out Report

The Joint Trial Operations Close-out Report (RfLI-OPS-OP-PLN-0019) focusses on the initial and immediate findings of both Phases One and Two of the Joint Trial Operations Programme immediately after its completion and as the Elizabeth line prepared for Entry into Revenue Service (EiRS). This report examined initial baseline proving objectives and success criteria against reportable data and metrics derived from the undertaking of the multitude of exercises across the Programme, and outlined initial findings that inform this document, as well as the Joint Trial Operations Case Studies, which are discussed below.

2. Executive Summary of Elizabeth line Joint Trial Operations

Trial Operations formed the final key phase of delivery towards successful completion of Stage 3 of the Crossrail project – opening of the Central Operating Section between Westbourne Park, Pudding Mill Lane and Abbey Wood as the Elizabeth line. The Project Development Agreement (PDA) (CR-XRL-Z8-AAG-CR001-50178) between Crossrail Ltd, TfL and the Secretary of State for Transport defined Trial Operations as ‘the undertaking by the Operators of tests and trials to prepare for and demonstrate that they are capable of operating the railway in accordance with the Sponsors Requirements and the Operators’ Safety Management Systems’.

The Joint Trial Operations Programme was originally developed in June 2017 in accordance with this definition in the PDA, and in line with the original Crossrail programme of delivery in August 2018¹. Following subsequent delays to the programme a further two major revisions were completed to the Joint Trial Operations Programme, culminating in v3.0 being signed 29th October 2021 ready for entry into Trial Operations.

Despite significant challenges, including the splitting of the programme into two phases, the Joint Trial Operations Programme was successfully concluded on the 23rd March 2022, and the evidence produced supported the entry into Revenue Service on the 24th May 2022. We delivered over 150 scenarios across five mass volume Volunteer Exercises (with almost 5,000 volunteers), over 50 Live Staff exercises (including three multi agency Emergency Service exercises), and almost 40 Planned and Unpublished exercises.

Were there surprises along the way and elements that didn’t go as were expected at the planning stage? - **Absolutely!**

Are there things we have learnt in hindsight that we can share with others to avoid similar challenges? - **Certainly!**

Are we happy that overall, we were able to successfully plan and deliver a large and complex Trial Operations programme, and identify areas of success that could be replicated in future similar programmes? - **Definitely.**

This report details some of the pitfalls and successes and we hope provides you with useful food for thought if you are embarking on a similar journey towards a period of Trial Operations.

3. Lessons Learnt Development and Methodology

3.1 Lessons learnt workshops

The RfLI Operational Readiness team conducted a series of Lessons Learnt Workshops alongside internal RfLI teams as well as with the stakeholder organisations that took part in the programme of exercises. These interviews took place with the LUL Leads, MTR Stage 3 Lead, MTR Customer Experience Leads, MTR CBTC Integration Manager, MTR General Ops Manager, RfLI Maintenance Lead, RfLI Trial Operations Team, RfLI Network Operations Manager, RfLI Operations Specialist, and Network Rail Leads.

These workshops were broadly framed around the following themes, which also informs the structure of this report:

¹ With a series of preparatory desktop exercises conducted from March 2018.

- Governance & Meetings
- Programme Structure & Methodology
- Stakeholders and Engagement
- Roles & Responsibilities
- Progress Monitoring & Reporting
- Exercise Delivery

3.2 Volunteer feedback

Feedback from members of the public who participated in the five Live Volunteer Exercises was collated by the RfLI Operational Readiness team.

Feedback relevant to passenger or customer experience such as staff helpfulness, built environment comfort, customer information and evacuation experience were included in overall Trial Operations weekly exercise reporting (see Appendix 5 for the full list of feedback questions). Key volunteer feedback themes have added additional context in the Joint Trial Operations Close-out Report, particularly from a customer perspective.

Feedback relevant to participants' experience as an exercise volunteer (such as, whether they felt well-informed and briefed ahead of the exercise and on exercise day, their welfare during the exercise, helpfulness of event stewards, and appropriateness and clarity of health, safety & security provisions) were reviewed weekly to inform continuous improvements. This feedback has informed the volunteer exercise planning and delivery lessons learned documented in Appendix 6.

4. Governance and Meetings

4.1 Governance structure

The governance structure implemented for the JTO programme was a success in that it enabled clear decision-making and an effective route of issues escalation and resolution, while programme change management and control was at times an area for improvement.

Sun-up and sun-down calls were held on exercise days to ensure all components necessary for a successful exercise day were in place and conduct an initial review of the outcomes of the day's exercises. The Head of the Exercise (HoE) would then assign a pass, pass with comments, or fail result to the exercise, for weekly review of exercise outcomes by the Trial Operations Delivery Working Group (TODWG), chaired by the Operational Readiness Manager. Above TODWG, the Trials & Operations Review Group (TORG) weekly meeting, chaired by the Deputy Director of Operations for RfLI and attended by RfLI, LU and MTREL Operational Readiness Managers, served as the point of escalation and resolution as needed for any exercise outcomes and follow-on actions implementation.

All exercise outcomes were either ratified or overturned and resolved through the JTO programme meeting and reporting structure.

4.2 TODWG and TORG

TODWG was considered useful across the board to get all stakeholders together at the right level of management on the same page at the start of each week to review the week prior, followed by a look ahead. The meeting was split into two sections; Monday morning TODWG focussed on review of the previous weeks exercises, further discussing and ratifying exercise results with the

involvement of additional stakeholder input and confirming any additional actions required. The second section Monday afternoons looked at the programme of exercising four weeks ahead and confirmed required arrangements were in place for their delivery. This split was well received as not only did they have some differences in audience (some people only need look-ahead information whereas others were only concerned with reviews of exercises that had already taken place) but they also allowed focused discussions around either planning or review. It should be noted however that the look ahead portion of TODWG spent a large proportion of time looking at the immediate week ahead, particularly as we got into phase two of the programme and significant change was occurring. It may have proved useful to convene a separate, smaller and more focussed meeting to define key actions required in T+2-4 weeks to then bring to the TODWG planning session and additional stakeholders required to support their closure.

Furthermore, the sun-up and sun-down meetings were well received and thought to be important to get everyone on the same page before an exercise (sun-up) and then also to follow up actions quickly after an exercise (sun-down). All meetings during Trial Operations adapted quickly and seamlessly to the onset of the pandemic.

TORG was a useful forum to review progress at a more strategic level and, where necessary, escalate actions or decisions that were unable to be unlocked at TODWG. However, attendance at TORG was sporadic at times, depending on what other priorities were pulling on attendee's time within the wider project. A more robustly enforced quorum with defined delegates for attendees when they were unavailable would have been useful.

Overall, the structure of daily sun-up/sun-down meetings, weekly TODWG week in review and plan ahead for up to the next four weeks, and a weekly TORG meeting worked well to keep the rhythm of the programme.

4.3 Independent Advisory Panel

While not part of the formal governance structure, prior to entering Trial Operations, an Independent Advisory Panel (IAP) reviewed the JTOP, reviewed and advised on key programme risks and risk management. The IAP comprised of experienced rail industry professionals neither directly involved or invested in the delivery of the Elizabeth line, or members of Crossrail, RfLI, LUL, NR and MTR.

The IAP provided immensely valuable expert review and advice for the JTO programme in areas including but not limited to: the clarification and communication of JTO programme vision and purpose, managing the dependency of Trial Operations on completion of Trial Running, continuity of supplier support contracts beyond Trial Running to prevent disruptions during Trial Operations, mitigating the potential impacts of a compressed Trial Operations programme, bringing JTOP planning and delivery closer to key decision gate points for overall entry into revenue service, and forward planning towards embedding operational lessons learnt from Trial Operations exercises into BAU operations.

5. Programme Structure & Methodology

5.1 Transition from Trial Running to Joint Trial Operations

The Crossrail document Trial Running Exit and Trial Operations Entry Criteria for Testing Phases (CRL1-XRL-08-STP-CR001-50163) stated the activities which must be proven before Trial Running can end and Trial Operations can commence. While the original intent was that JTO

should only commence after sufficient reliability to run a 12tph timetable had been demonstrated, alongside safety, maintainability and other reliability proving objectives had been met, due to the longer time needed to exit Trial Running we ran a handful of Trial Operation exercises during the end of Trial Running period. In retrospect perhaps we could have conducted more planned and published, lower-disruption operational trials during the final stages of the Trial Running period, once safety-related Trial Running proving objectives had been met.

On one hand, conducting JTO only after reliability proving had been completed, the railway's systems were functioning in a BAU state and all requisite software updates had been completed and proven would have allowed for a more solid baseline on which to undertake disruptive exercising and enhanced the fidelity and realism of the exercises. However, it was also noted during lessons learned interviews that performing exercises on a sub-optimal railway was realistic (for example, signallers often must deal with multiple concurrent incidents and issues) and helped develop the confidence and experience of staff involved in running the railway. The reality was also such that time was of essence and waiting for the railway systems and train reliability to be 'perfect' was not feasible within the wider Crossrail programme constraints. It would therefore be sensible to 'bake in' as much flexibility at exercise design stage as possible, understanding how exercises could be adapted to account for disparities in planned versus actual system functionality or reliability.

5.2 Programme timeline

The original single-phase JTO programme was split into two phases to adapt to changes in the reliability proving and software update schedule, and Tunnel Ventilation System (TVS) issues which prevented more than 20 people being allowed on a train in the COS at a given time. As shown in Figures 1-2, Phase 1 delivered the majority of the simpler Planned and Unpublished (P&U) exercises whereas Phase 2 would deliver all larger scale, complex Live Staff and Volunteer exercises.

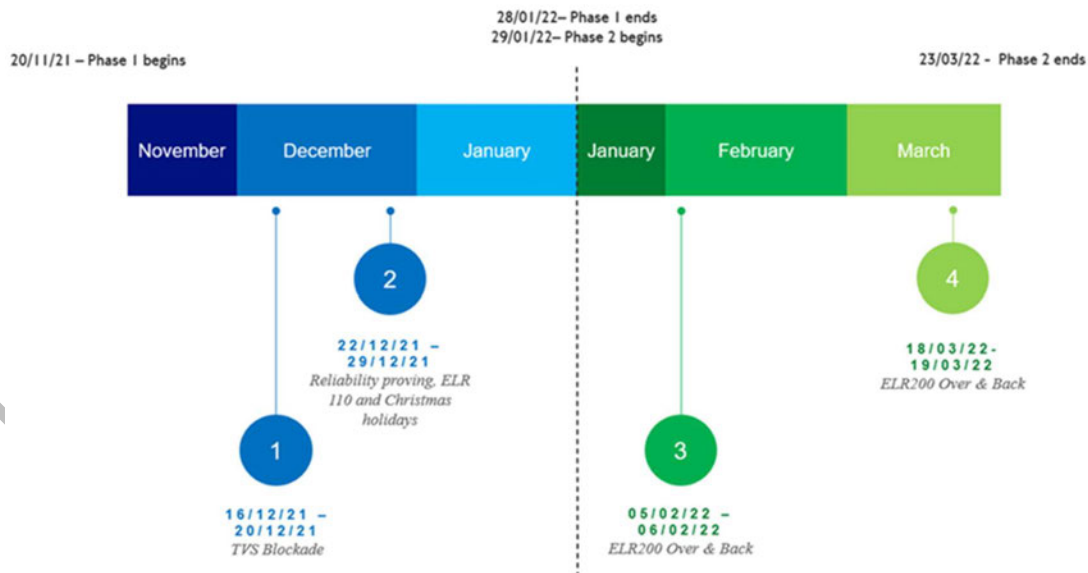


Figure 1 - Phased delivery of joint trial programmes and non-exercise periods blockaded for software updates and reliability proving activities

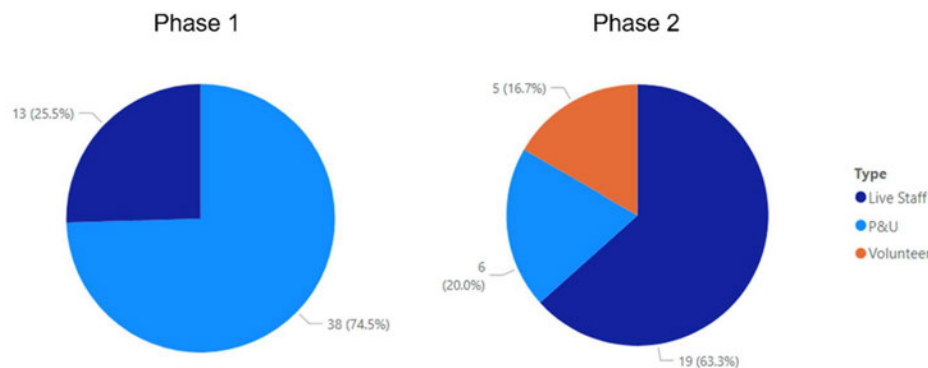


Figure 2 - Comparison of the proportion of Planned & Unpublished Live Staff, and Volunteer exercises within each phase

The impact of phased delivery was that stakeholders felt the repetition of P&U exercises in Phase one reduced operators' interest and engagement, while the concentration of complex exercises in Phase two compressed intense periods of critical activity which led to challenges with exercise staff resourcing, staff fatigue, scheduling of external stakeholders, operational staff rostering, turnaround of exercise lessons learnt communication and actions close-out.

While the JTO period delivered was as long as it was intended to be in terms of end-to-end calendar duration, as Trial Operations was shifted to later in the year, the programme crossed over the Christmas/New Year holidays and software update blockade periods restricting when exercises could take place. The reduction in number of days available for conducting exercises compressed the JTO programme and time between exercises, which meant the business often did not have enough time to embed lessons learned from exercises into the relevant teams prior to the exercise, or related exercises, being repeated. This heightened the risk of iterations of the same exercise failing multiple times due to the resolution of actions on the back of earlier exercises not yet being closed out. We encourage future Trial Operations programmes to consider sequencing and spacing out repeated and dependant exercises to allow for sufficient time for closing out post-exercise actions, embedding lessons learned (such as through process updates and staff re-briefing communications), and enabling continuous improvement between exercises.

5.3 Programme scheduling and assurance

Due to the volume of information on the programme, exercise coding was used to keep programme documentation concise. It was noted by some stakeholders that the programme schedule and exercise coding was confusing, as there were times where those involved in enabling or delivering exercises were unsure what was going to happen, where, when and who was involved. More could have been done to make the published schedule of exercises more user-friendly and earlier investigation and sourcing of better software to produce the schedule may have allowed a clearer, more communicable programme of exercises to be produced. This issue was compounded by the inaccessibility of the SharePoint area by people outside of TfL and frequently revised versions of the programme being circulated.

Programme assurance (through earned value) could have been baked in earlier into the programme. This would have helped to facilitate a deeper understanding of the concept amongst key stakeholders in the JTO programme.

A positive that was often noted during the lessons learned workshops was that the program was agile and adaptable through delays and alterations (phased approach and ELRs) as well as the onset of COVID. This meant that it could accommodate frequent and sometimes complex changes to exercise scheduling and the need to conduct and manage the program during a global pandemic.

5.4 Programme change control

An area for improvement was programme change control and communication. This was partly a resourcing issue as well as the speed at which the programme had to be modified to respond to sudden change.

It was felt by some groups that the programme changed too regularly, often at short notice, and that the change control mechanism in place to track changes and notify relevant groups could have been more consistently enforced. This also may have been compounded by the confusion around exercise coding and technology issues mentioned above, such as the need for more seamless SharePoint integration / information storage and sharing across JTO organisations.

Trial Operations programme integration and change management would have been strengthened by having an embedded resource from key groups involved in delivering the JTO programme, such as MTR, LU, NR and the RfL Infrastructure Maintenance team. The presence of an embedded resource from these groups would have allowed for earlier flagging of potential risks, schedule conflicts, engagement issues and information gaps. Embedded resource would have also prevented there being a single point of failure for communication within a particular organisation, ensuring messages were fed back throughout the partner organisations.

5.5 Simulator room and (V)SDEs

In late 2018, following news of the initial Crossrail programme delay, the RfLI IM Operations team had a cohort of Traffic Managers and Service & Infrastructure Managers who had been expected to be undertaking their substantive roles within the control room. To support the maintenance of their competencies and provide an opportunity to bridge the original JTO desktop exercises with the future live exercises, the JTO team identified the concept of Simulated Desktop Exercises (SDEs). These SDEs made use of the simulator room (containing power and signalling training workstations) adjacent to the Route Control Centre to run JTO scenarios and observe the RfLI and MTREL control teams² respond.

These sessions took place weekly (outside of training utilising the simulator) and rotated staff through various JTO scenarios. These sessions were useful to the JTO programme by identifying opportunities to expand or improve on planned exercises based on the (as close as possible) to real responses being observed – for example the interventions that would be required by the JTO team to drive a scenario were adapted based on the operator responses during SDEs. It was also a good opportunity to preview challenges to processes and procedures, such as line blockages, enabling us to make sure there were sufficiently appropriate scenarios to trial these during JTO.

They were not without their challenges. The simulator was designed to be a replica of software undergoing live testing on the railway. As such it required several workarounds that were not required in the end state. Performance of the simulator was also poor initially with regular crashes

² Note: due to the limited size of the simulator room this did not include all roles, for example rolling stock In Service Support Technician

of the software leading to lost time, and in some cases abandoned exercises. These issues did gradually ease and the value we obtained from running SDEs far outweighed the challenges. Although they were never originally part of the JTO programme design, they became a key element, and we would strongly suggest adopting them (or similar) if future programmes have simulator availability.

COVID-19 put a temporary stop to SDEs, however our operational teams were not furloughed and so we adapted the concept again in Spring 2020 to run Microsoft Teams Virtual SDEs (VSDEs) using slides and injects in the virtual environment (a blend between traditional desktops and the SDEs we had been running). Although primarily used as a tool to keep staff engaged and thinking 'operationally', and we certainly hope we do not see another pandemic that mandates them again, they do reflect the flexibility of the JTO programme and could have useful applications for future programmes or related areas (such as scenario-based interviews etc.).

6. Stakeholders and Engagement

6.1 Stakeholders

Stakeholder groups central to Elizabeth line operations and the JTO programme were:

- RfLI Operational Readiness team: responsible for the development and execution of the Joint Trial Operations programme (JTOP),
- RfLI Network Operations: responsible for signalling, electrical power management, incident management (in conjunction with MTREL), incident response on the EL COS. Based at the Romford Control Centre (RCC) in Romford,
- RfLI Maintenance: responsible for proactive and reactive maintenance of the COS infrastructure and systems,
- MTR Elizabeth line (MTREL): Train Operating Company (TOC) of the Elizabeth line, customer services in the COS, driving of Elizabeth line trains, and staffing and management of 5 COS stations where there are no direct interfaces with other LUL sub-surface tube lines,
- London Underground Ltd. (LUL): IM and SFO of 5 COS stations where this is a direct interface with LUL's other sub-surface tube lines,
- Network Rail (NR): IM of the national rail network, and IM and SFO of Paddington and Liverpool Street mainline stations where RfLI's infrastructure borders NR's infrastructure.

Peripheral operational stakeholders included groups such as the Emergency Services who had an active role in select exercises, and Berkley Homes.

This section below discusses stakeholder communication and engagement within RfLI, as well as across the Joint Trial Operations organisations.

6.2 Stakeholder communication

Communication channels used to promote awareness and support for Trial Operations within RfLI included a regular Trial Operations burst as part of the Deputy Director, Operation's update at the Chief Operating Officer's fortnightly virtual town hall call. It also included the dissemination of the Elizabeth line Trial Operations Weekly Round-Up newsletter, which summarised exercises undertaken in the past week and shared examples of best practice and exercise lessons learned.

To boost change readiness for entry to Trial Operations, support morale, and foster a stronger sense of ownership and shared experience throughout the JTO period, the Trial Operations team may have looked to augment communications promoting the purpose, context, activities and progress of the programme to the RfLI community and other direct and enabling stakeholder groups through more targeted communications and active engagement. Stakeholder engagement was particularly important for Trial Operations because the programme was, by design, adaptable. Hence by its nature the JTO programme was likely to elicit the need for quick and frequent response to change which often called on the discretionary efforts of people in other areas of the business (going out of their way and going the extra mile). To support and reward discretionary effort to go beyond what would normally be required of roles in BAU operations, a focus on engagement was important to foster a shared sense of ownership and identification with overall JTO objectives.

An earlier launch of the newsletter, or a bulletin within existing all-staff communication, would have been beneficial for supporting the readiness for transition to Trial Operations, and could also have been used as forum for recognising the efforts of operational staff participating in the exercises earlier in the programme.

It may have been beneficial for a business communications resource to be semi-embedded within the Operational Readiness team, to manage weekly information collation and content creation for JTO communications, with a focus on engaging and sharing learnings with teams across organisations directly involved in BAU operations. This dedicated communications resource could also have formed the link to a broader RfL Staff Engagement initiative.

There is a general view that we could have communicated the importance of Trial Operations earlier to various stakeholder groups (RCC, driver community, maintenance staff)³. This could have been done by visiting them, ideally in person, and communicating the broader objectives and implications of the programme, their potential involvement in ensuring it is successful and the level of possible disruption they could expect. Some more work around how JTO was branded and made these groups feel ownership and enthusiasm for aspects of the programme may have built more buy-in from these communities earlier, recognising the wider disruption that was being experienced (we needed to cut through more 'noise' than originally anticipated).

Some groups such as station staff and drivers also felt that they were being tested. It was important to reiterate to these groups that the programme was not testing individuals but wider processes, rules and stakeholder interlinkages. While this was done early on, it could have been repeated more often. Some specific areas where engagement could have been improved are discussed below.

6.2.1 RfLI Network Operations at the RCC

Romford Control Centre (RCC) staff did not always understand why many exercises were 'unrealistic' in terms of the application of process, for example, that the JTO team had to artificially manufacture a situation to drive a specific reaction to successfully observe and verify that it could be carried out according to the requisite rules, processes and procedures from all involved. Briefings to RCC staff, and perhaps the IRMs, in terms of how exercises were structured in the way they were may have eased some confusion.

³ Various detailed briefings presentations were given to a number of groups since late 2017, however a refresher after entry into ROGS would have been beneficial.

The intention was to spread as much of the exercising as equally as possible across the RfLI control teams (to avoid some being part of many exercises and others part of few or none). Staff turnover, sickness (exacerbated by COVID-19) and additional requirements for the control teams during the Trial Operations period, along with constraints for when certain exercises could take place (for example the majority were within service hours), made this challenging. If this is an intention for other Trial Operations programmes it would be worth considering adopting some rostering expertise into the team on a temporary basis to evaluate how to best align the exercise programme with rostered staff. Other opportunities, such as offering overtime to staff under-exposed to exercising could also be considered, however planning and budgeting for this would need to be considered at an early stage.

6.2.2 MTREL driver resourcing and wider IR issues

Doing 'roadshows' with MTREL's train drivers explaining the differing types of exercises, why they were being done (and why the programme was necessarily disruptive to acquire a full operational response), and how they were spaced out within the dual Phases of the Programme would have demonstrated that JTO was planned and measured. This may have alleviated some of the frustrations exhibited by MTRELs driver community. In future programmes, consideration could also be given to engaging with key groups such as drivers to flag concerns earlier such that appropriate mitigations could be identified. In our case a much longer, and significantly more disruptive Trial Running period resulted in a driver community that had been significantly inconvenienced through late finish times as an example. This resulted in a lack of willingness to take part in exercises that would incur additional disruption, leading to a much more limited demonstration of contingency plans than had been planned.

Prior to the start of the JTO period the MTREL Programme Management team were largely disbanded leaving a single point of interface with increased workloads, which resulted in a bottleneck for some activities, or things becoming lost in a wider conversation. The consideration of this report is that if any significant team changes, regardless of organisation, are being planned, it would be best to avoid implementing these changes immediately before a significant step change in the programme.

Once it became clear that driver relations concerns would impact on delivery of exercises, the JTO team re-coded the programme of exercises to indicate the likely level of disruption each exercise would cause to drivers. This coding can be seen in Appendix 7. Although useful to frame discussions around how to mitigate disruption to drivers whilst still achieve the objectives of the exercise, it would have been ideal to have had this available as a core part of the programme from the outset. It is worthwhile considering building an indicator like this into future programmes, and potentially for other key groups where engagement could be a challenge.

6.2.3 RfLI Maintenance

Feedback received during lessons learned interviews suggested that many cross-organisation stakeholders, including from within the RfLI Maintenance team, believed that maintenance involvement in Trial Operations was not as extensive as it could have been. This held back quantities of Earned Value from the Maintenance segment of the Programme (those exercises which required a maintenance presence), and therefore under-represented maintenance within the overall output of Trial Operations.

Although there was direct engagement from a Maintenance representative, this was not as consistent as with other stakeholders (the individual providing the link into maintenance changed

three times), resulting in challenging onward communication about what was required of Maintenance in terms of delivering Trial Operations. A more consistent single point of contact within the maintenance team earlier with delegated ability to directly input into the plan in order to deliver on the requirements of the programme, both internal and external, would have been beneficial. This was acknowledged by Maintenance as being strongest in the final Maintenance Lead, however they came into the role late in the process – earlier engagement with that individual would have allowed for a keener focus to be placed on maintenance aspects of the Programme at a time where necessary changes could have been more easily implemented to make overall JTO delivery more straightforward.

‘Town Hall’ meetings could have been held at Plumstead Stabling Sidings by the JTO team to engage with the wider on-duty team and to get their buy-in and engagement with the programme. This could have demystified the Programme to those on the front line of the Maintenance organisation as well as providing a pool of Observers to take part in exercises, such as observing IRMs as part of an exercise.

Having earlier dedicated buy-in and engagement from Maintenance would also have helped the JTO team with the nuance of maintenance-focussed exercises in terms of reporting to enable a more full and contextualised discussion, with additional technical and infrastructure detail which the JTO team didn’t have as a specific capability within the pool of Exercise Planning Managers, HotEs, Observers, TOTLs or TOEDs.

6.2.4 Emergency Services

Engagement among the Emergency Services was excellent, with some very good discussions to clarify how a given exercise would be carried out in the planning phase and said exercises then being undertaken alongside integral industry partners. A series of separate meetings were held with leads from each of BTP, LAS and LFB in the lead-up to the exercises taking place to put specific emphasis on the unique planning requirements for these exercises. Having a nominated lead from each of the Emergency Services was beneficial to drive consistency and we would suggest future Trial Operations projects seek similar nominated leads (with nominated substitutes if the lead is unavailable).

We proactively engaged with other key stakeholders ahead of each of the three exercises. Two that were particularly key included the TfL press office, who prepared proactive communications to assure onlookers the presence of the Emergency Services was planned. The second key stakeholder was the London Borough of Newham, who were engaged through TfL Surface and provided off-street parking access for Emergency Services vehicles in an unused bus layover, avoiding the need for on-street parking next to Custom House station during a person struck by train exercise. This proactive engagement helped to maintain positive relations with the council and local community.



Figure 3 - Emergency Services Person Struck by Train exercise

In terms of challenges scheduling repeats of any exercises involving failed emergency services was extremely difficult due to Phase 2 of the programme being relatively short. Combined with the Emergency Services own staff rostering timescales (which was also heavily impacted by COVID-19) this meant that some repetitions were not possible to carry out before the end of the JTO programme.

7. Roles and Responsibilities

7.1 Team integration & representation

During lessons learned interviews, stakeholders across JTO organisations mentioned that additional cross-programme integration and coordination across MTR, LUL and RfLI would have created better transparency of the breadth of exercises being undertaken both as part of the JTO and complementary to it, and that a variety of elements were being trialled within these exercises, for example, customer service and maintenance as well as train operations. It was also mentioned that the visual tracking of all the exercises undertaken by all three organisations (rather than just RfLI) on the dashboards that were presented at TORG would have been useful to understand the overall picture of cross-organisation activities and the status of activities. While this was originally intended and LUL data was captured through TOOC as well as JTO observation data, MTREL trials data was not available at the time for cross-organisation trial reporting integration due to the technology barriers mentioned above.

Figure 4 shows the reporting structure of the core Operational Readiness team. While the MTREL Stage 3 Delivery Manager, LUL Senior Readiness Manager and NR Operational Readiness Manager were key partners and interfaces in delivering the trial operations programme, in retrospect it would have been beneficial to embed additional MTR, LUL and NR members as part of the core Operational Readiness team at the exercise planning and delivery level, to support stronger cross-programme coordination and stakeholder engagement across COS organisations.

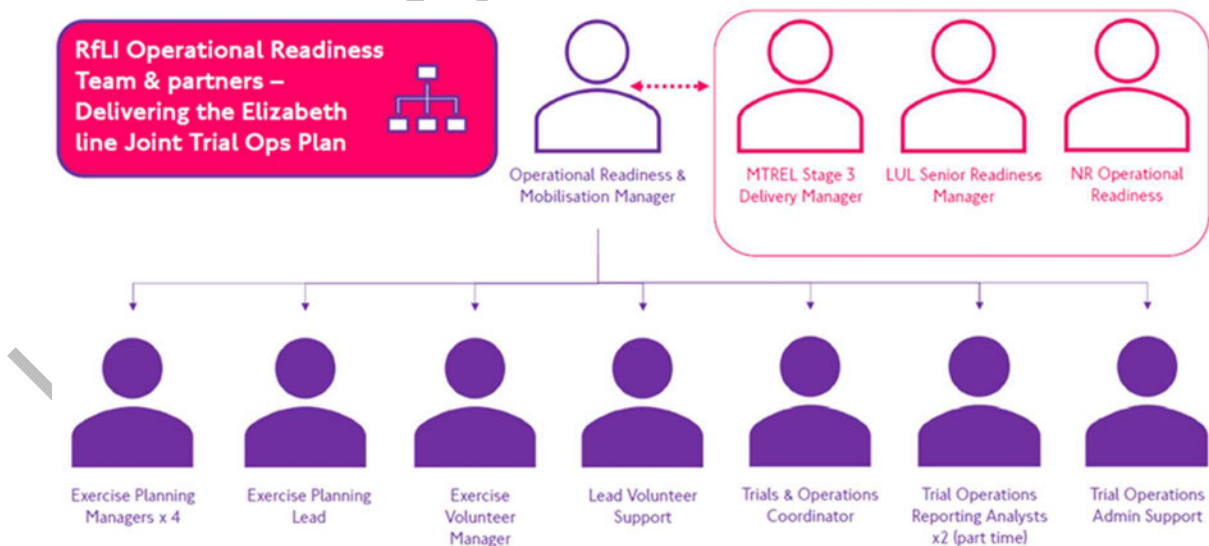


Figure 4 - Operational Readiness team structure

7.2 Exercise roles

The structure of the roles on the day such as TOTL, HotE, TOED was generally considered a good approach. Exercise roles were filled by individuals in the Operational Readiness team, TODWG and TORG members (exercise roles were not full-time staff roles). The reporting structure of these roles for any given exercise worked as shown in Figure 5.

Having said this, dedicated training sessions prior to the start of the Trial Operations programme for all roles would have been beneficial and create clearer consistency between role holders (e.g., through dummy exercises or workshop sessions), particularly

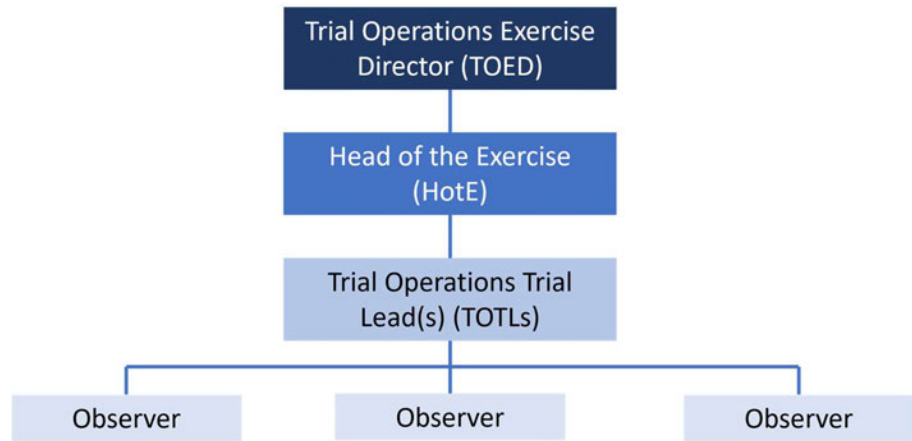


Figure 5 - Reporting structure of exercise roles

for HotEs.

Furthermore, some

HotE's briefed RCC and exercise staff fully while others didn't – this should have been uniform (and of the same high standard) throughout all exercising. This would have served to provide consistency in the level of detail provided to operational staff about the day's activities, requirements, goals, timescales, etc.

It would have also been useful for every HotE to have a general observer to help capture a timeline and to give note-taking support in the hot de-briefs. Oftentimes it would be difficult for a HotE to be an observer at the same time as having to manage the overall progress as well as using TOOC, typing a timeline and having to listen to every conversation in the room. This was often sensory overload.

Observer roles were split into role observers, i.e. those undertaking observations of the exercise through role participants on TOOC, and general observers. It was sometimes necessary to remind observers that their role was not to intervene and that the declaration of how an exercise went must be reserved until the conclusion of the hot de-brief, in which they had plenty of opportunity to share their observations and viewpoints. It is worth considering regular inclusion of this guidance in pre-exercise briefings.

The TOED role was beneficial to provide daily structure and a point of escalation, and it was good to have a broad range of perspectives as the TOED roles were filled by senior members from different JTO stakeholders. However, it would have also been useful to build a training / briefing strategy for TOEDs to support a base level of consistency and emphasise the need to be semi-agnostic to their parent organisation when passing comment on exercise results and in assigning actions.

7.3 Team welfare

The distribution of the programme into two distinct phases, with Phase 2 delivering all the most intense exercises together in a short period of time alongside the programme compression, meant

that staff across various locations and organisations started to feel burned out and disengaged with Trial Operations. This was most observed for train drivers and staff in the RCC. When the programme started to feel like a burden on these groups and they did not see the value in it, reduced flexibility in responding to the needs to the program and more push back against exercising was observed. This issue may not have arisen had we pre-empted the engagement issues and spread exercises more evenly across the duration of the programme. Furthermore, many of these groups were already fatigued by the sustained pressure of Trial Running, while this had to some extent made them 'battled hardened', it may have also had the effect of reducing their enthusiasm and energy for Trial Operations.

Burn-out also affected many individuals within the core JTO team as well as key stakeholders assisting in programme delivery. Possible solutions to ease the strains of programme compression on these individuals would have been to have the evening sun-down call cover that morning's exercise and the evening prior, but not the exercise that just happened that afternoon, to give HotEs time to write things up without working excessively long hours. Simplified flash reports containing just the result, key actions and safety concerns (with the full details in the final report) would have also given HotEs more time to collate the exercise information and write it up. Finally, not having the post-exercise debrief and just wrapping everything into the sun-down may have freed up people's time and prevented the same information having to be delivered twice.

8. Progress reporting and actioning operational lessons learned

8.1 Earned value

Every exercise delivered as part of the Joint Trial Operations programme had a numerical value attributed to it that corresponded to its criticality, complexity and the trials that comprised it, in order to track how the JTO programme was supporting the Elizabeth line COS being ready to enter Revenue Service – this was called Earned Value.

For more information regarding Earned Value please see Appendix 3. Additional useful resources on this topic include the Joint Trial Operations Plan (RFLI-OPS-OP-PLN-0003) and the Joint Trial Operations Execution Plan (RFLI-OPS-OP-PLN-0008). Understanding the delivered vs. planned Earned Value (EV) allowed the Operational Readiness & Mobilisation team to determine where any issues were being encountered in the delivery of the JTO programme, and in addition to other reporting mechanisms, allowed the team to focus on the reasons for any encountered issues, to address these, and raise actions as necessary to facilitate resolution and allow for replanning of said exercise(s) within the Programme.

EV was very beneficial to the JTO programme, however its creation and adoption came fairly late in the day (the team had been struggling to define a single progress metric until EV was proposed in a review by the Crossrail Independent Advisory team). We would suggest considering use of EV as a model in future Trial Operations programmes and 'baking' it into the core of the programme and planning from inception. Not only would this give better opportunities to drive consistency in reporting from planning through delivery, it would also save work down the line where resources are pitching towards delivery.

8.2 Flash reports

Flash reports needed to be moderated for language and occasionally came across as a little pointed. Suggestions to solve this included clearer guidance on a 'writing style' for TOEDs to review, or even the creation of a separate role to ensure consistency in documentation. The impact

of having to write up flash reports on the author's working hours also needed to be considered more carefully.

As the flash reports developed into lengthy documents throughout the course of JTO, one solution could have been to have included just the critical actions, safety concerns and initial result in the flash report with more details to be added into the final report, to give the HotE more time to write up the details, easing the burden on their working hours. However, having the details early after the exercises was useful so an alternative solution is the creation of a separate role to support the HotE in the control room with capturing the details, meaning the HotE doesn't have to spend time later on writing up this information. This support role would be akin to the Information Coordinator role who supports the SIM in the control room.

Having said this, flash reports were, overall thought to be essential and important despite the point raised above and provided a useful daily drumbeat of results and items being captured.

8.3 JTO action tracker

An extensive Action Tracker was compiled by the JTO team as a result of the outcome(s) of exercises within the programme. Within this, actions pertaining to exercises were categorised based on their severity in terms of risk profile and also their criticality with regards to the requirement to have said action closed or mitigated prior to entry into revenue service. Additionally, each action was placed within a general theme/topic area linked to the action itself. A dedicated team member was assigned to monitor and track progress, build progress metrics and highlight key actions within Power BI reporting. This was useful to be able to keep on top of overall numbers of actions in progress versus closed-out.

8.4 Learning lessons whilst still in Trial Operations

It was challenging to embed lessons learnt whilst still heavily engaged in the delivery of the Programme. While the JTO team could share lessons learnt, there was very little time in which to embed this learning within the various requisite teams because of programme compression (as mentioned above), in addition to the standard factors of rostering, leave, sickness and briefing timescales. Operations Control staff were notified of rapid changes to be enacted and briefed to their team; however, this was widely acknowledged as challenging to manage. The volume of information that required distribution contrasted with the time available and the number of staff who needed it. This meant that while actions were being processed within the action tracker, it was difficult to confirm if they were being fully embedded effectively within the business. This is the most important reason why it is key to retain as much programme time as possible in order to be able to space out exercising as much as is feasible to in turn provide 'air gaps' where sharing of lessons and briefings can be conducted. Dedicated lessons learnt 'champions' from key stakeholder teams could have been brought into the JTO programme at a more detailed level to directly support onward briefing of outputs as they occurred and decentralise sharing from the core JTO team.

9. Exercise delivery

9.1 Exercise packs

Exercise packs were created early in the process of planning JTO. Originally, they were in MS Excel and were then migrated to Word documents and included details such as the proving

objectives and success criteria, key participants and exercise staff and the flash report templates. Once the Trial Operations Observation Collection (TOOC) app (detailed in Section 9.4.1) was developed this took away elements originally expected to form part of the exercise pack and had it been known the programme would have been delayed to such an extent it would have been worthwhile further developing TOOC with the Crossrail IT team to migrate the remaining elements from the exercise packs into TOOC. This would have supported the team in focusing on generating additional uniformity and more advanced issuing of packs to stakeholders.

In some instances, where programme changes occurred, final exercise packs were issued less than 24 hours before exercise start. Additional detail would have also been beneficial in terms of train and driver resourcing that would have supported briefing to drivers and control teams, which as previously discussed would also have benefitted from an embedded MTREL resource within the Trial Operations team to directly input to.

9.2 Communication

Additional GSM-R radios or an alternative exercise communication tool would have improved on-the-day communication. The lack of 4G/5G/Wi-Fi within the COS tunnels made it difficult for TOTLs to communicate with the HotE during exercises where they were not able to be located with a driver or IRM when between stations (stations had good access to Wi-Fi to allow WhatsApp messaging and calling to be utilised).

9.3 Infrastructure and equipment readiness

There were some infrastructure defects and equipment issues during the Trial Operations programme, such as the lack of adequate clips, scotches, and cabinets at some locations. However, these issues highlighted the value of the programme – while this equipment should have already been in place, JTO identified that they were not and provided a forum to raise this and hold groups accountable until the issue was resolved. It also provided final validation and sense of assurance that these issues were being captured, followed-up and closed out to support safe operation of the railway in passenger service, rather than potentially waiting to be discovered in passenger service.

9.4 Technology

While there were a multitude of technologies and systems in place to manage JTO, some other areas were lacking and impacted some of the ways in which JTO was delivered. Some of these were known or anticipated, others less so. General IT was leveraged positively within the Trial Operations programme, such as by using the bespoke TOOC application to deliver exercises and track results and using interactive dashboards to visually manage trial results and monitor programme progress.

9.4.1 TOOC

The Trial Operations Observation Collection (TOOC) app for iOS devices was designed by the RfLI Operational Readiness team alongside CRL's IT department to be used to capture real-time observations of a given role within an exercise, and the way in which that role operated/performed according to the requisite rules, processes and/or procedures based on the task at hand. The fact that the TOOC app was developed in-house was a major win for the program in that it cost significantly less than externally provided solutions and was tailored to the exact requirements of the Trial Operations program. This was a great example of internal collaboration and teamwork.

The TOOC app also allowed for specific observations to be noted (or photographed) allowing for additional context to be added to a given question. Some of this commentary provided useful information and lessons both regarding the management of exercises, and/or the way in which the exercise was handled.

The TOOC app was broadly agreed to be an extremely useful and innovative piece of technology that allowed the Operational Readiness & Mobilisation team to observe roles within exercises based upon the rules, processes and procedures they were anticipated to follow as part of a given exercises scenario and remit. Additionally, because the app and all observations for each trial within the Programme has been pre-completed prior to Phase One of Trial Operations, it proved to be a helpful tool when reacting to short-term/late notice schedule changes as the app would update the observations for a given day almost instantaneously. This was far preferential to using a paper-based system which carries numerous inherent risks such as loss, damage, additional administrative requirements, and so on.

It was noted however that the wording of certain observations within the TOOC app could have been more refined with regards to their wording, making statements more overt or detailed in order to facilitate more detailed responses, particularly against aspects of a certain task that were deemed safety critical actions within the RfLI Rule Book. More details on TOOC can be found in Appendix 4.

9.4.2 Connectivity and sharing

It was known/anticipated that there would be a lack of 4/5G or WiFi in the COS tunnels due to CRL overrunning and programme delivery priorities. This meant TOOC data upload could only be done when back above ground. Because this was a known factor, RfLI's Operational Readiness Manager and CRL's IT team designed TOOC to be able to be used offline, so as to not impede its use and the gathering of observational data used in the assurance of the Programme.

However, a persistent impediment to effective, efficient information sharing and coordinated joint programme delivery was the inaccessibility of the JTO SharePoint space (hosted by TfL) by key trial operations external stakeholders such as those in MTREL. Future cross-organisation readiness programmes must consider early on in programme design an information sharing and storage system which is accessible by all working group members and allows for flexibility as the programme and staffing profile evolves. This would enable all organisations directly involved in delivering the programme access to a single source of truth for necessary information quickly and accurately, avoiding delays and miscommunications in programme delivery.

9.4.3 Filming

Limited filming of some JTO exercises was carried out by CRL internal media staff. This footage was largely used by CRL for promotional use, on their YouTube channel for example. With hindsight, it could have been beneficial at an early stage in planning key exercises to 'storyboard' potential filming opportunities for use as operational briefings, legacy learning or training aids. Involving teams such as Training, for example, to develop detailed storyboards and use cases would have allowed for more accurate resource requirements being defined, including camera operators and editors, and would also have allowed these resources to make first passes at editing the footage. This would then have only required the JTO team to review before final editing – as previously identified, due to the pace of JTO the team's time was challenged with producing standard exercise outputs and spending time editing film footage was a luxury that could not be afforded.

9.5 Volunteer exercises

See Appendix 6 for a detailed account of lessons learnt from volunteer exercise planning, management and delivery.

Volunteer exercises were broadly considered to be well organised and executed.

Having a standalone volunteer exercise workstream led by a dedicated Volunteer Exercise Manager role was a critical factor in the successful delivery of live volunteer exercises, as volunteer exercises involved several additional stakeholders and business processes in addition to those required for other trial operations exercises which did not involve hundreds of members of the public acting as live 'passengers'. Additional capability required included communication, stakeholder engagement, and customer experience skills.

Having detailed volunteer exercise delivery planned out well in advance and communicated to stakeholders was extremely important, and we found the use of detailed Volunteer Exercise Guides and pre-briefing slides and scripts good tools for this. The Volunteer Exercise Guides and briefing materials communicated the day-of timeline and 'asks' of all stakeholders involved in the lead up to exercises and on exercise day clearly, to ensure the safety and wellbeing of volunteers alongside successful exercise delivery from the operational perspective.

Additionally, having sufficient resource in the team to support with lengthy multi-stakeholder administrative processes (such as procurement, movement and storage licenses, liability insurance coverage reviews, to name a few) and site set-up during exercise weeks was a definite necessity. The Volunteer Exercise Manager was supported by a Deputy Volunteer Exercise Manager starting from the detailed design stage of volunteer exercise planning, through to the end of the final volunteer exercise. Additional Trial Operations team members supported event site set-up in the week leading up to each volunteer exercise and supported day-of as lead marshals at each event location.

A good reporting tool on numbers recruited also supported senior management needs well – a Power BI dashboard was used to give visibility of progress against the event delivery plan and communicate feedback from volunteers to senior stakeholders at TODWG and TORG.

We would recommend holding live volunteer exercises as a useful tool for proving operational readiness, but also for engaging the public and media, supporting staff readiness for operations and as an engagement piece internally for staff who have worked on the project.

10. Conclusion

The Elizabeth line Joint Trial Operations Programme was complex, ambitious and at times extremely challenging to deliver. This was against a backdrop of similarly challenging delivery for the entire Crossrail project. The programme was designed a year out from the original expected implementation date and remained largely unchanged until three years later when application of SDEs, then COVID-19 and an extended Trial Running period prompted review and tweaking of the plan. However, the core underlying principles of the original JTOP remained unchanged even with the final challenge of splitting the programme in two.

We hope that the narrative within this report gives you food for thought if you are about to, or thinking about, enter a Trial Operations programme. As a final thought, below are the top five things with hindsight that we would propose doing differently, and the top five things that were successful and are an opportunity to be embedded in future programmes.

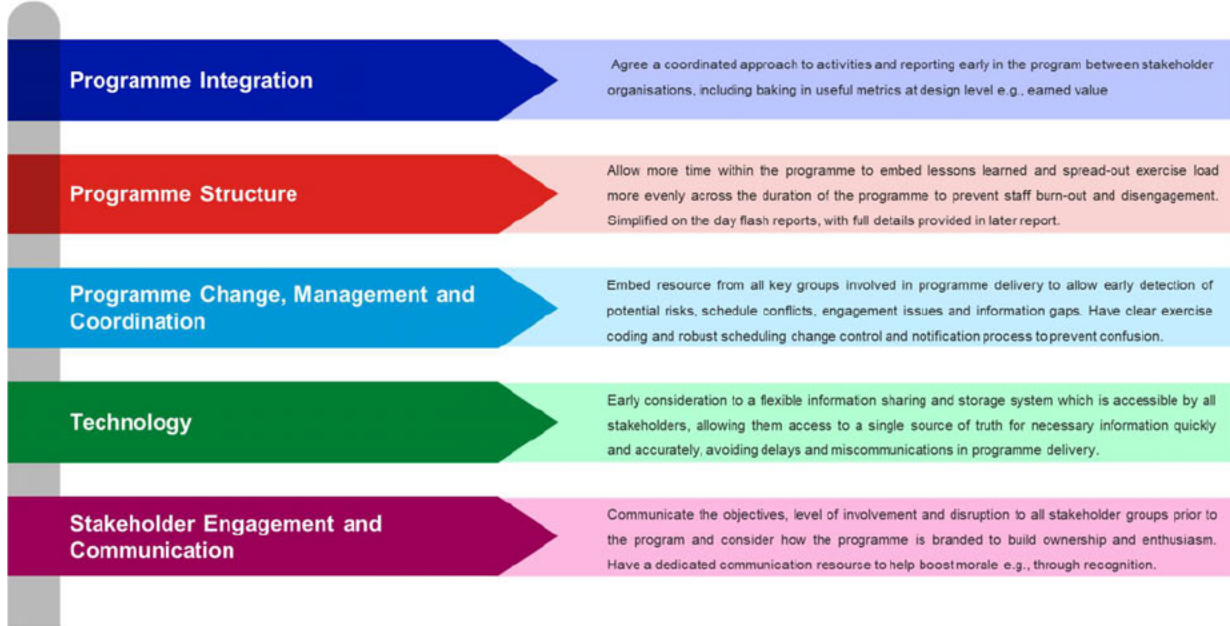


Figure 7 - Top 5 areas for improvement



Figure 6 - Top 5 areas of success

Appendices

Appendix 1. Referenced Documents

Documents used in the preparation of this document are listed in the table below and referred to by their reference numbers in the document.

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendment) applies.

Ref.	Document Reference	Document Title
1	RFLI-OPS-OP-PLN-0003	Joint Trial Operations Plan
2	RFLI-OPS-OP-PLN-0008	Joint Trial Operations Execution Plan
3	RFLI-OPS-OP-PLN-0019	Joint Trial Operations Close-out Report
4	CR-XRL-Z8-AAG-CR001-50178	Project Development Agreement
5	CRL1-XRL-08-STP-CR001-50163	Trial Running Exit and Trial Operations Entre Criteria for Testing Phases

Appendix 2. Terms, Acronyms and Definitions

Acronyms, abbreviations and terms used within this document are listed in the table below.

Term / acronym	Definition
CESAC	Crossrail Engineering Safety and Assurance Case
COS	Central Operating Section
CRL	Crossrail Limited – the organisation delivering the Crossrail Project
EiRS	Entry into Revenue Service
EL	Elizabeth line – the eventual name of the service that the Crossrail Project delivers
HoTE	Head of The Exercise
JTO	Joint Trial Operations
JTOEP	Joint Trial Operations Execution Plan
JTOP	Joint Trial Operations Plan
LU(L)	London Underground (Limited)
MTRC	The company operating the rail concession for the Elizabeth Line
NR	Network Rail
ORR	Office of Rail and Road – Government Department for regulation of railways
PDA	Project Development Agreement
RfL	Rail for London
RFLI	Rail for London Infrastructure Limited – the Infrastructure Manager for the CCOS
SMS	Safety Management System

Appendix 3. Earned Value (EV)

Introduction and definition

Earned Value is a quantifiable metric in which the 'value' of a given trial and exercise was determined. As delivery of the trials progressed, RfLI Operational Readiness demonstrated actual Earned Value against forecast Earned Value, which contributed to the conclusion of whether the programme had delivered against its objectives and supported ongoing decision-making during Trial Operations in the event any exercise(s) needed to be replanned.

This combined analysis by TODWG members was presented as a planned overall value to be achieved through delivering Trial Operations against a real time forecast of achieving that plan. This helped to inform recommendations to T&ORG (and above) for any scheduling changes that needed to be made to the programme. The determinations provided assurance to senior management groups that due diligence had been applied for any modification to the programme in order to deliver the maximum benefit in line with the proving objectives and success criteria of the Joint Trial Operations programme prior to EiRS.

Earned Value model

A notional base value of 50 was applied to all trials. As exercises often were composed of multiple trials, an aggregate exercise base value was acquired – an exercise with a single trial had a base value of 50, and exercise that comprised three trials had a base value of 150.

Following this, a multiplier tariff was applied to the exercise base value dependent upon the type of exercise as displayed below:

Multiplier	Rationale
x1	Planned and Unpublished - simple
x2	Live Staff Exercise – simple
x3	Planned and Unpublished - complex/ high frequency
x3	Live Staff Exercise – complex/ high importance
x3	Live Staff Version of Volunteer Exercise

An Example of the EV calculation process is shown in Figure 8.

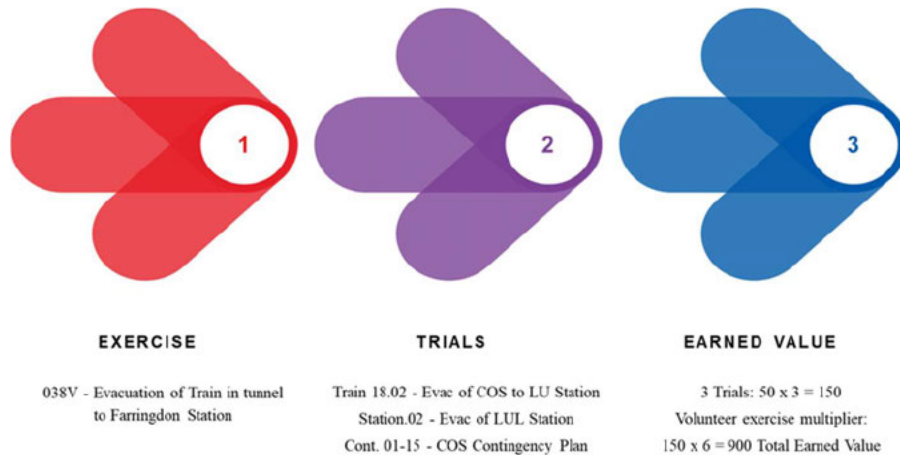


Figure 8 - Example Earned Value calculation

Earned Value pillars

The base value of 50 assigned to every trial was further subdivided between the 5 pillars of Safety, Operability, Performance, Maintainability and Customer Proposition. Each pillar was also tracked and reviewed individually throughout the program to ascertain the position and level of confidence under each pillar.

The breakdown of Earned Value by pillar for some example trials can be seen below, this breakdown must add up to the base value of 50 for each trial:

	Safety	Operability	Performance	Maintainability	Customer Proposition
Poss.01 Possession and Isolation (COS)	25	10		15	
Ops.02 IRM Response to Incident	25	25			
Cont.01-15 Contingency Plans		15	15		20

Figure 9 - Example Earned Value breakdown by pillars

Appendix 4. Trial Operations Observations Collection System (TOOC)

The Trial Operations Observations Collection System was designed to support the trial operations phase of the Crossrail project. The system comprises of a web site and an IOS based mobile application. The TOOC website allows the creation of a draft exercise that consists of one or more trials. Each trial contains one or more roles. Roles can be assigned an observer.

Once a draft exercise has been created and published, the system generates an observation for each assigned observer. An observation form comprises of a list questions associated with a role being observed, along with various instructions and injects used to guide the observer through the trial they are observing. Observers can use the TOOC mobile app to complete an observation form in real time whilst the exercise is in progress. Completed observation forms can then be uploaded to the TOOC system where results of the trials and exercise can be analysed.

The image below shows the web-based TOOC interface:

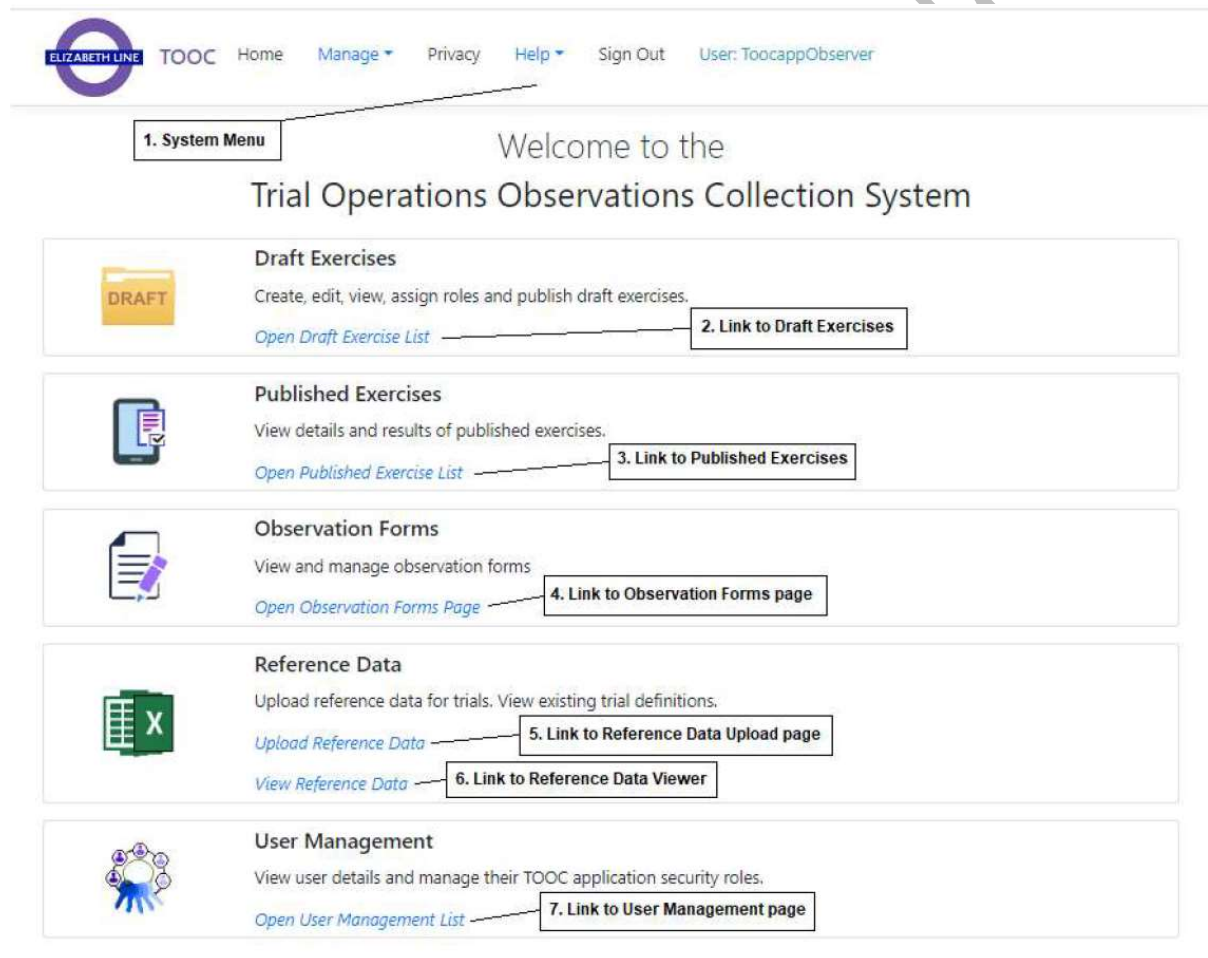


Figure 10 – TOOC desktop interface

Appendix 5. Volunteer Exercise Volunteer Feedback Questions

Participants were sent the following feedback form via email after attending each volunteer exercise:

Thank you for participating in the Elizabeth line Trial Operations exercise today! We hope you had a fantastic time, and congratulations on being one of the first to see inside Elizabeth line stations and experience the train journey!

Please share your feedback with us in the form below. Your responses will help us to improve the next Volunteer Exercises, and give us vital information on how our response was from a customer's perspective.

This feedback is extremely valuable so please provide as much constructive criticism as you can. We encourage you to be open and honest.

All responses are completely anonymous. The form should take no more than 5-10 minutes to complete.

(Response options: Strongly agree; Agree; Disagree; Strongly disagree)

1. The information I received by email before the event was relevant and helpful.
2. Event staff (individuals in pink and purple high-vis) were helpful and gave clear directions.
3. I felt informed and prepared once I received the event safety briefing on the day.
4. On the train, staff (including the driver, and other operational staff) were calm and confident.
5. On the train, communications to passengers were timely and helpful.
6. In the station where the exercise ended, station staff were calm, confident and helpful.
7. In the station where the exercise ended, instructions to passengers were clear and easy to follow.
8. In the station where the exercise ended, signage was easy to follow.

(Response options: Very positive; Positive; Negative; Very negative)

9. Overall, how would you rate your experience of the Trial Operations Volunteer event?

(Free response)

10. What is one thing that would have improved our Trial Operations Volunteer experience?

Appendix 6. Volunteer Exercise Planning & Delivery Lessons Learned

Management and governance

The governance structure was set by the Operational Readiness team very early on but having a dedicated Volunteer Exercise Manager was critical to their success – it would not have been feasible for the Exercise Planning team to plan, manage and deliver live volunteer exercises in addition to the other exercises they were delivering as part of the programme, particularly in the context of a compressed Trial Operations exercise schedule. Additionally, the Volunteer Exercise Manager role provided the passenger perspective to exercise planning, rather than being Operationally led, which was extremely important to providing a positive experience to the volunteers.

Positives

- Having safety & security risk management centralised in a role in the Trial Operations team helped to plan and manage risk on the Volunteer Exercise in a streamlined manner.
- Being able to rely on the Trial Operations governance process through the Trial Operations Delivery Working Group (TODWG) and the higher-level Trial Operations Review Group (TORG) meant that any blockers or problems could be raised with senior representatives and be resolved more quickly, particularly last-minute problems.
- Holding a site set up session on site 3-4 days ahead of exercise day, followed by a team walk through and final check the day before, worked well for managing the weekly set-up process. It helped having fresh eyes on the Friday walk through to ensure nothing was missed.
- Scaling the exercises up from least complicated (easiest to manage) to the most complicated worked well, as lessons could be implemented to improve and streamline processes as we went.
- Leaving one week between each Volunteer Exercise is the minimum we would recommend – any less and it is difficult to turn around and implement lessons effectively.
- Using a t-minus led action tracker for each exercise meant the Volunteer Exercise team flag conflicting deadlines for each exercise and view any outstanding items very easily.
- Having a deputy Volunteer Exercise Manager made a big difference, both in managing time-consuming preparation processes such as procurement, but also as the exercise end-location site lead.

Room for improvement

- If we were to repeat these exercises, we would implement and uphold a strict change control process early on. This was not enforced until too late, which meant that last minute changes were happening and the risk for not informing a party increased.
- Stakeholder maps and key contacts for each exercise would have been another useful management tool, in order to quickly update relevant parties when needed, especially last minute.
- The Volunteer Exercise Guides were incredibly useful when detailing during the Planning stages and proved a useful tool for stakeholders to reference back to. However, they

became cumbersome when changes were made and towards the end of Trial Operations they were not updated as regularly as they should be. We would recommend handing these over to another member of the team (such as a central PMO role specifically focused on Volunteer Exercises) to manage as a process and keep up to date, as it proved too much for the Volunteer Exercise Manager when also out on site delivering.

- We found that a week between each exercise was not enough time to implement any significant operational or exercise administration improvements.
- We found that briefs to Station Managers often did not make their way down to station staff teams, because of rostering the Station Managers opted to wait until the day of the exercise, where it would have been better if they could have briefed the entire team ahead of time.
- Exercise packs for each Volunteer Exercises (separate from the Volunteer Exercise Guides) should be prepared well ahead of time, because of the stakeholder involvement and need for parties to know information well ahead of time.

Logistics and procurement

Logistics plans and procurement processes for the Volunteer Exercises proved to be the most time-consuming part of the process. We recommend starting these earlier than you think, at about 3-6 months out.

Positives

- We held a pilot exercise 6 months ahead of the first Volunteer Exercise, which proved to be an excellent opportunity for proving some processes work and finding areas for improvement on others. It was also useful to test the supplier process for catering and security and familiarise station staff who had not ever had “passengers” before.
- Outsourcing as much of the high-volume materials we needed for the events through existing suppliers worked well – for example, the caterers were responsible for compiling the catering bags, and the thank-you bag supplier was requested to deliver the bags in boxes with all contents pre-packed off-site.
- Pin badges and information booklets were most well received by volunteers, but thank you bags and catering were generally overall well received.
- Procuring extra thank you bags for staff delivering on the day and enough catering for all staff present was a good decision.

Room for improvement

- We were not aware of a station process around moving and storing items and that these needed licences to be completed. This resulted in a rush to get these done and work arounds, so we would advise enquiring with venues/locations on any paperwork that needs to be completed well in advance.
- We would have also mapped out processes for procurement or other detailed processes early on, so multiple team members could pick this up when needed, for example, for raising a shopping cart or who needs to sign off at each level.

Registration and ticketing process

We decided to use existing structure for this process via the TfL Events Team. Benefits of this was the team already knew the software well and were happy to help manage the process for us, including setting up of ticketing sites, replying to queries and helping with check-in on exercise day.

Positives

- The software chosen allowed us certain security measures which were important for a high-profile set of events. This included only being able to register if you had pre-registered on a mailing list, limiting ticket numbers to a central staff member and their three guests and preventing the link to the ticketing site from being forwarded on.
- By amassing a “register your interest” mailing list, we were able monitor how many people were interested, which gave us some comfort that we would fill our spaces once ticketing opened.
- The ticket sent to the volunteers was a QR code, which allowed for speedy checking in on the day, as the software app would scan the code and check the guest in. We could also automate a reminder email the night before with the QR code included for volunteers.
- We set target recruitment numbers for each exercise to simulate real passenger loads, and we over-recruited for each exercise by 10%. This helped ensure we accounted for a drop-out rate of approximately 20% on the day.

Room for improvement

- We should have uploaded all TfL staff onto our mailing list / approved list to make the process less clunky for staff.
- We attempted to enforce a lower age limit of 16 but the software would not allow for this, so we had to turn away three guests who weren't old enough, despite signposting this lower age limit several times. However, we believe we could have comfortably allowed over 11's and would recommend this for future exercises.
- In hindsight, we would clarify the costs of using the software as we were surprised that the Events teams 'tokens' ran out and we had to purchase more at a higher rate.
- We would also potentially look at a more thorough tendering process to ensure the in-house option was definitely the best. While it was very useful to have the team of experts, the cost involved could have been spent on a more sophisticated system.

Pre-event briefing

This process involved three steps – first volunteers were sent a briefing pack one week out from each exercise, which was hosted on MS Sway. This detailed directions, an overview of the day, what the volunteers should / shouldn't bring, FAQs and key safety information. This was re-sent to them the night before with their ticket reminder. Secondly, the volunteers were given an A5 flyer when they checked in which had a summary of the timings, key safety information and key welfare information (i.e. food and toilet provisions). Finally, a 10-minute safety brief was delivered to all volunteers just before they boarded the train, which was mandatory for all participants to listen to. This provided more detail how the day would run, reiterated key safety information again and set expectations for volunteers.

Positives

- Hosting the briefing pack on an MS Sway webpage which could be updated proved to be very useful, particularly for last minute changes or travel advice. It also proved to be easier to manage than multiple PDFs.
- A second, more detailed briefing pack was sent to volunteers who had additional needs such as a disability or who had requested further information. This detailed processes for evacuating volunteers who use a wheelchair, the additional routes of escape that would be used and emergency procedures, which was well received.
- The in-person safety brief was very well received, and feedback highlighted the balance between the serious safety notes and a more light-hearted tone worked well. A British Sign Language interpreter's presence on stage for the brief was also well received.

Room for improvement

- There were some changes that happened between volunteers registering and getting their briefing pack, particularly around Covid-19 restrictions, so maintaining a stricter change protocol and highlighting this would have been beneficial.
- The timescales used in the communications were our best guess, but we could have made it clearer that we didn't know exactly how long evacuations would take, as some exercises overran the timeframe given.
- Emphasising any public concerns and how you are addressing them is useful and reassuring to volunteers. For our exercises, Covid-19 was particularly present, but terrorism or other security concerns should be addressed too.
- We did not create a public webpage about Trial Operations, but in hindsight this would have been a positive thing to do.
- We did not have the functionality available but if we had, sending a reminder text message the day before instead of an email would have reached more volunteers and perhaps would have improved the drop-out rate.

Safety and security

The safety and wellbeing of the volunteers was paramount throughout the Volunteer Exercises, which both amounted to their risk exposure during the exercise but also general items such as risk of someone using the events for a terrorist attack or volunteers becoming violent if denied entry.

We used a private security company to conduct a bag search of every volunteer upon entry to the event. We also had at least two members of the BTP Specials force with us on every event, which helped to deter public interest and meant they were on hand to step in if something did happen.

Volunteers all signed a set of terms and conditions upon registering which included several security terms such as not bringing prohibited items and agreeing to a bag search.

Positives

- Procuring a private supplier for security reduced risk as they were highly experienced and could be left to manage the bag search area on their own.

- Using the same team across all exercises was positive and meant the team really got comfortable in their role by the last exercise.

Room for improvement

- Having the BTP attend the exercise itself made some volunteers nervous, as they were asked for by the driver as part of the scenario. This happened last minute and so we did not brief the volunteers that this was all part of the exercise, so some reported feeling worried BTP officers were asked for over the PA system. In future we would ask BTP to act as a member of the public during the exercise.
- It would have been beneficial for a member of the team to be on board the train specifically to deliver updates to the volunteers outside of the driver communications. If this was a familiar voice i.e. the person who delivered the safety brief, this would have gone a long way in reassuring volunteers that work was happening, and the exercise was progressing as it should.

Volunteer welfare

Welfare refers to providing sufficient toilet facilities for volunteers and keeping them warm and dry.

We were restricted on our exercises by not having any toilets available in the stations or on the trains, and while we tried to find several solutions, the best ended up being to ask the local pub if volunteers could use their bathrooms at the starting station.

At end location stations, we were lucky that local toilet facilities existed next to the stations which we directed volunteers to on request and A5 leaflets given at check-in on the day.

Two of our exercises took place outside, and so we made sure volunteers were reminded to dress appropriately and had a number of umbrellas and foil blankets on standby for bad weather.

Positives

- We hired a cleaner to manage the pub toilets as part of the agreement and return them clean afterwards. This worked well and was appreciated by the pub.
- We stocked emergency toilet provisions with our Safety Marshal on each train, which were never needed but it was better to be prepared! Volunteers were told there was an emergency provision if they needed it.
- We made regular announcements over the station PA to remind volunteers to use the toilets before the exercise, which worked well.

Room for improvement

- Toilet provision is never enough! We used the Purple Guide standard of 1 toilet for every 100 people but often found there were queues.
- We experienced problems with toilets not flushing due to how slowly the tank refilled at several locations. This caused problems with queues getting longer and was unpleasant for volunteers.
- Communication about toilets relied on volunteers having read their briefing pack, so we installed someone in the queue to mention it to volunteers before they joined the queue in to the event.

- We would recommend hiring a plumber to be able to respond as needed to problems with toilets, which we did for our lifts by having an emergency engineer already on site. This would have solved some problems for us on the day.
- If weather looks bad, make sure you have plenty of provisions for volunteers in way of blankets, gloves, umbrellas, and hot drinks, particularly if you are asking them to be outside as part of the exercise.

Catering

We used internal providers for our catering, which consisted of a small brown bag that consisted of a pastry, piece of fruit, snack bar and bottle of water. The bags were well received by most, and we ensured a decent offering for vegan/gluten free/other dietary requirements.

We overstocked the dietary requirements by 10% over just in case and ordered the full number of bags despite knowing we would have roughly a 20% drop out rate.

We used a handstamp or ticket for each person to collect their bag to prevent people from taking more than one and made the decision not to offer hot drinks because of the mess and risk involved.

Positives

- The catering was very well received, with lots of positive feedback. We stored water in a separate area for volunteers to help themselves to which worked better than trying to store one in each bag.
- We had one marshal on each type of pastry, allowing volunteers the choice which was positive, and then had one runner to keep each area topped up. Tablecloths helped the area look professional and good use of signage was important too, particularly for those with special dietary requirements.
- We had a lot of leftover fruit but found that putting it outside the station with some station staff resulted in some very positive community engagement.
- The leftover breakfast bags were taken by station staff which helped to keep them engaged and happy!

Room for improvement

- We relied on the supplier to get the items to the event and to get the bags made up. We did not realise they were arranging for their supply chain to deliver directly to the station rather than to them first, which on one day resulted in water being delivered very late and parking tickets being issued to supplier vehicles. We recommend ensuring the key contracted supplier arranges delivery to themselves first and brings all items in one trip to your exercise location.
- We would recommend the use of small cardboard boxes instead of bags, as these are stackable and much easier to distribute to volunteers.
- We tried naming bags for those with dietary requirements but found that these did not get collected as much so would recommend just keeping to categories (such as, gluten-free, dairy-free, nut-free).

Staffing

To help manage each event day, we had a Volunteer Exercise staffing structure made up from the Operational Readiness team which remained the same across each exercise, and to supplement and support this we recruited Event Marshalls from the TfL Travel Ambassador community. Each exercise had between 20-50 Marshalls who helped to manage the queue, check in, catering, thank you bags and exiting processes. Without this structure it would have been difficult to deliver the exercises in the way we did and get so many people into the stations in the short time we had available.

Additionally, we had the external security provision as previously mentioned as well as the station team who were overstaffed on the day in order to support. This proved highly useful when Marshalls cancelled last minute. We also had a great representation of staff from wider TfL teams such as Corporate Communications, Operations and others who we knew we could call on if needed.

Positives

- Marshalls felt they were sufficiently briefed, which followed the same pattern as the volunteers with a briefing guide one week out and a safety brief and role allocation on the day.
- We also benefited from support from the MTR Community Ambassadors who brought a stall with giveaway items and provided great enthusiasm and support, which made a difference!
- Our station manager and station staff teams went above and beyond throughout, adding extras such as custom announcements and stepping in to help where needed. Having the team “on side” made a huge difference.
- Using an Incidence Response Manager (IRM) as a Safety Marshal was helpful for our risk management, and meant we were reassured someone who was track certified could respond if things went wrong outside of the exercise.
- Having two Trial Operations Exercise Directors (TOEDs), one at the signalling centre for leading the operational/technical exercise and one on site at the exercise start station for high-level stakeholder engagement and volunteer aspects oversight, was valuable and made running the event much easier. Having a TOED on-site at the start location allowed the Volunteer Exercise Manager to focus on managing volunteer check-in and briefing processes and volunteer exercise logistics on the day.

Room for improvement

- We consistently saw around a 30% drop out from Marshalls, because the roles were voluntary and unpaid. We would recommend over recruiting for this, or offering time off in lieu for people’s time.
- We moved some Marshalls with volunteers from the start location to the end location, where they stepped in to help with exit processes. This really made a difference, but we would still recommend having more Marshalls at the exit location ready to go. Where it is anticipated that Marshalls will need to be moved from the station location to the end location to support at both locations, we recommend pre-briefing Marshalls on their end-location role and requirements in advance.

- We would recommend bringing more of the Operational Readiness team on site even without roles, so they can support as Head Marshals as they are more familiar with station locations and on what is involved in the day.

On-site structure / running

Generally, site management was a success each time, with the Volunteer Exercise Manager and the Trial Operations Exercise Director both available to react and respond to any problems that occurred, as well as managing media processes and reception of VIP's.

Positives

- Having a separate team to manage the check in process who were well versed with the software was a huge positive – it meant that they could operate autonomously and only needed support with queue management. It helped they were also an existing Events team so were aware what the environment was going to be like.

Room for improvement

- Some volunteers had a long wait time from when they arrived to when the exercise started. We could have included better entertainment or more chairs for volunteers to sit once checked-in, and increased the number of staff for even faster check-in.
- On a couple occasions the exercise start was delayed. In hindsight we should have made announcements informing volunteers, even when there was only a 5–10-minute delay. It would have been better to over-inform and explain the delay than a lack of communication – which is easy to forget on the day when you are dealing with the problem that caused the delay.
- Station teams should be better prepared to give volunteers onward travel advice, particularly as part of an evacuation process.
- We could have made better use of the London Transport Museum and had a few more stalls for volunteers to engage in before the start of the exercise.

Appendix 7. Driver impact ratings

Negligible (N)	Moderate (M)	High (H)	Severe (S)
<p>No noticeable disruption to drivers except minimal delay to specific driver involved in scenario – driver to be chosen who is not on last trip.</p>	<p>Noticeable but manageable delay to one or more drivers – across service up to 2-5 minutes delay per train. Suitable windows to be chosen where majority of drivers not on last trips.</p>	<p>Significant disruption to drivers – may involve blockage to single lines and delay to drivers over 7 minutes. Requires operation of contingency plans. Consider additional resource, including any incident train.</p>	<p>Severe disruption to drivers – generally emergency scenarios involving prolonged blockage of the line across both lines. Consider reduction of tph to mitigate or suspension of timetable (in some cases already done).</p>

Learning Legacy