

COPING WITH UNCERTAINTY AND DISRUPTION IN TRAVEL BY PUBLIC TRANSPORT

Workpackage 2 Report



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Cover Picture

Tramworks causing disruption in the West End of Edinburgh. Image Copyright Kim Traynor. This work is licensed under the Creative Commons Attribution-Share Alike 2.0 Generic Licence. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-sa/2.0/> or send a letter to Creative Commons, 171 Second Street, Suite 300, San Francisco, California, 94105, USA.

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Workshop 2 Coping with uncertainty and disruption in travel by public transport: information and technology to support secure and confident travel

Introduction

The workshop reported on in this Work Package 2 Interim Report is part of the project “Enhancing transport technologies to support personal security in travel by public transport: Scenarios for 2040”, funded by the EPSRC.

Background: public transport information and personal security

A key premise of the project is that not being in the position of being able to make informed decisions about a journey can contribute to a feeling of insecurity when travelling. In certain circumstances this can turn a convenience or reliability issue into a matter of personal security. The focus of the workshop reported on here, travel disruption, is one such circumstance in which personal security could become compromised. Information provision is integral to addressing this problem as it enables contingency planning to be undertaken by travellers.

Achieving standards and services to better enable bespoke, real-time contingency planning would make a significant contribution to enhancing personal security of travel by public transport, and may offer benefits to operators and security authorities as well, by managing expectations, and preventing the escalation of relatively small events into larger scale, more disruptive incidents. However, previous research has demonstrated a disconnection between transport technologies and end users, with negative consequences for user experience and effective technology uptake (Beecroft *et al*, 2007). This project focuses on the interaction between technology and user needs in supporting personal security in travel on public transport, with the aim of developing fundamental understandings of this interaction. This will then enable better identification of the types of transport technologies that would better support personal security.

The early work of the project has highlighted that the term ‘personal security’ suggests a number of apparently conflicting domains, from the harder ‘Security’ and prevention/protection from crime and terrorism, intersecting with the unease caused by the low-level nuisance of anti-social behaviour, through the thoughts about personal physical safety to personal confidence as a mobile individual, depending on the perspective of the participant (whether that be emergency services, national security and police services, operators, Health and Safety personnel, transport authorities, information providers, PT user groups or car drivers. In order to encourage participants to think broadly when considering what constitutes personal security, a conceptual framework for

considering personal security in a holistic way was developed in Work Package 1, see Figure 1.



Figure 1 Conceptual Framework for Considering Personal Security (developed by the authors)

Personal security is most commonly interpreted as being related to crime and anti-social behaviour. However, at the personal level, the affective nature of fear of crime clearly impacts on confidence to travel. Thus, there are likely to be other aspects to the term, depending on the perspective taken as described above. Based on analysis of the material generated in Work Package 1 our conceptual framework for personal security comprises a combination of three overlapping aspects:

- threat to individuals from other people (e.g. crime, including terrorism, violence and theft, or intimidating antisocial behaviour),
- safety issues having an individual impact (e.g. from vehicle accidents, slips and trips),
- and personal affective issues (knowledge, confidence and attitude and perceptions about the risk of threatening situations and accidents),

The relative importance of each aspect varies according to stakeholder perspective – security personnel for example, are deeply immersed in the specialised nature of their work and focus on ‘security’ with a silent capitalisation, rather than on ‘personal’.

Workshop context

Workshop 1 considered public transport (PT), the travel information environment and its supporting technologies in general. In this workshop the focus is on making the best use of information services and new technologies to reassure and assist travellers when public transport networks, or individual

journeys, go wrong. The focus is therefore on disruption and the uncertainty that it causes. This workshop is the second in a series of five that use a scenarios approach to explore issues and key drivers that influence how to enhance technologies to support personal security in travel by public transport. Each workshop is focused on a different application area:

- 1 Provision for public transport traveller information
- 2 Provision for contingency planning to support travel by public transport
- 3 Automated public transport services
- 4 Demand responsive transport services
- 5 Secondary, unintended effects of security (anti-terror, crime and antisocial behaviour prevention) technologies in the travel environments

Participation in each workshop is intentionally diverse to ensure a wide range of perspectives are covered – bringing users, operators and service providers together to draw out new insights.



The workshop, held on 16th November 2012, was designed, organized and run by Dr Mark Beecroft and Dr Kate Pangbourne, both of the Centre for Transport Research, University of Aberdeen, and facilitated by Jane Dowsett, contracted through the Department of Business, Innovation and Skills. The workshop was held at The Innovation Space at the Department of Business, Innovation and Skills. A full description of the methods utilized in the project workshops can be found in Work Package 1 Report.

Programme

In the first part of the day participants were invited to consider how far personal security, safety and confidence are considered in the current provision of information about last minute changes, delays, disruptive events and emergencies, both to draw out problems and highlight good examples. This is analysed as a SWOT analysis of present conditions, highlighting opportunities for change and threats to those opportunities or from failure of systems.

In the second part of the day, participants will consider the key driving forces that will influence future treatment of these issues and the associated provision of traveller information, using the recognized technique of STEEP(L) analysis.

In the third part of the day, the scenarios exercise was designed to consider under a range of alternative futures disruptive events might occur and how transport systems and services might adapt to mitigate the impacts of disruption. This included speculation on the emergence of potential future services to support personal security through public transport information such as the development of bespoke and individualised services or the role of user-generated information content (e.g. crowd-sourcing). Example possibilities for

the application area are narrated within the framework of a set of pre-defined scenarios.

The timetable for the programme, and the list of participants are found in Annex 1 and 2 respectively. Two intended participants were unable to attend on the day and will be invited to participate through the expert interview part of the Work Package.

SWOT Analysis

The SWOT analysis was organized into four parts. Broadly, the first three questions (see Annex 3) provided a number of ways of exploring strengths and weaknesses in the way disruption at various scales is currently handled and how passengers and those wishing to start journeys are kept informed and supported to make alternative arrangements. Having uncovered a long list of current issues and gathered a number of good examples of best practice, question 4 focused explicitly on opportunities for improvements to resilience and recovery from disruption, many of which are directly relevant to supporting passengers' sense of personal security. In the same exercise, the 'flip-side' of threats were also discussed by participants.

We present the data here by interpreting the material relating to different perspectives about disruption first, i.e. its significance for different stakeholders, followed by the material relating to factors controlling the escalation of disruptions from small incidents to larger crises. Then we consider the data that fits into the SWOT analysis framework as Strengths, Weaknesses, Opportunities and Threats. Here we have collated and summarised the data into two tables, one for Strengths and Weaknesses and one for Opportunities and Threats (which were considered over a time horizon of 3-5 years). Several participants have recent and direct experience of the extensive planning and operational work involved in handling transport during the London 2012 Olympics. We have included the Olympic examples in a separate section and table, as the experience is so specific to that mega-event, yet clearly represents a unique Opportunity. The raw data collected by the Innovation Space software can be found in Annex 3, the material presented here is an extrapolation from that data, and the chronology of the data generation is subservient to the information conveyed by the data.

Perspectives on disruption

The participants in this workshop were particularly conscious of their institutional roles and responsibilities in relation to dealing with disruption. Perspectives on disruption were gathered according to stakeholder viewpoint: users, operators, information providers, security authorities, and transport authorities. There is value in reflecting on this material under the original headings as it informs the discussion of Opportunities and Threats below, in terms of which stakeholders should take forward opportunities or react to threats. The raw data can be found in Annex 3.

Users

Participants observed that users of PT can't always adapt their journey, but have to wait it out, because they lack the information required to change their plans, or are unaware of the scale of the problem. Responses will differ, some will manage their stress by using Smartphones to actively find a source of information about their predicament. However, in general they are the weakest stakeholder during disruption, and dependent on others, and on technology if they have access to it. At the individual level, the threat posed by disruption to a sense of personal security will depend on a number of factors, which vary hugely between people. However, overall, time of day is a particularly important factor – many people are more uneasy about personal security when undertaking late night travel, and lone women are particularly aware of safety during the hours of darkness. Whilst many people who are nervous of darkness and late night travel will have planned their journey to avoid the insecurity they feel in those conditions, disruption can result in them finding themselves in precisely that situation.

Operators

The operator reaction to disruption will depend on the nature of the disruption, and whether or not it is under their control, or that of a third party. This can make a big difference to the speed of resolution, or whether a relatively small incident escalates out of control. A number of operator strategies for mitigating impacts from different causes were revealed (it is not clear from the data whether these are already practiced, or whether they are suggestions for improvement).

- Operators should help each other by accepting tickets, regardless of type/operator of ticket held, in order to support passengers to complete their journeys. Disruption due to road/utility work can be planned for, but needs close liaison with Local Authorities and the Highways Authority (Transport Scotland in Scotland) to plan them and agree alternative routes/stops
- Disruption due to road congestion: make use of real-time information (RTI) to review running times, bringing in additional vehicles if necessary
- Inter-modal cooperation: TOCs should have agreements with bus operators to implement bus replacement services when disruption on train/tram will not recover quickly
- Contingency plans can often cause more disruption in the short term, but aim to aid service recovery in the long term.

One participant noted that rail operators are not using GPS to tell users where trains are on the line. This is presumably because the operators have not seen a benefit to doing so, as they have long-established special technologies for separation of trains from one another, utilising track segment and signalling data. Whilst this is not pin-point precise, it has been 'good enough' for RTI.

Information providers

The information provider's perspective is that their role is to coordinate operator messaging, by trying to make sense of stories which differ in their detail. They then aim to proactively message their customers to try to prevent

the escalation of problems caused by new passengers attempting to enter a disrupted network. For example, information could stop passengers from entering a mainline station when it has no trains departing or arriving. The overview that information providers have shows them how the scale of impact is dynamic, and requires a different message to go out in different places or at different times. For example, a small delay of a few minutes at one end of an Underground line could result in a delay of tens of minutes at the other end of that line. This means that different passengers will be affected in different ways and will need information tailored to whether they are on the affected train, or waiting to catch it or later trains at other stations.

Security authorities

In many ways, the perspective of the security authorities is rather different to other stakeholders. The significance of their role in relation to public order, national security and emergency response means that there is a distinct set of legislation, regulations and objectives that govern their actions. Depending on the nature of the disruptive incident, legislative/regulatory processes can take over, preventing those immediately on the scene from controlling the situation because the nature of the incident means that law requires that it be scaled-up to other authorities or requires a specific response e.g. suspicious incident at level crossing, crime/terrorism etc., require intervention by another authority who 'takes over' responsibility for coordinating actions. In the box below we draw on insights from Transec 2012 on the pressures on first responders.

- National incidents generally weather related and regular – floods or forest fires. These are inherently dangerous, and the focus of the emergency services is on containment and protection of life.
- The suspected terrorism incident involving a coach on the M6 toll road was a learning experience. The response was much greater than it will be in future – it caused disproportionate disruption. New types of incident are always likely to have a disproportionate response. The important thing is to evaluate and learn from the experience for the future.
- For first responders, wider impacts on the transport system impacts are not always first priority; they seek to deal with incident first.
- To minimise wider impacts, early incident liaison between operators and emergency services with timely communication is critical
- The incident commander has to be informed about the priorities of all parties in incident in order to take them into account.
- Using RTI for dynamic risk assessment using RTI can inform decision making
- Interoperability amongst resilience community (not just emergency services) is required (e.g. compatible communications equipment)
- Trained staff are often a better investment than technology

Transport Authority

From the perspective of transport authorities, there is a recognition that all stakeholders have a role to play. Mitigating disruption requires collaboration,

which is founded on having already built strong relationships between key partners. This can be fostered through regular resilience planning events. In relation to a privatised and deregulated environment, appropriate contractual arrangements and obligations are critical. However, these are not the concern of passengers, and part of the role of transport authorities is to understand and anticipate the needs of passengers so that these can be embedded in mitigation strategies. Transport authorities have a legal role in relation to travel information, and are concerned that the messages are consistent regardless of operator. However, they do not always have the means to control this fully. Both issues and customers do not recognise these sometimes arbitrary organisational boundaries, and part of the task of the transport authorities is to create an impression of seamlessness. In the box below we draw on relevant material from the Transec 2012 conference. The key elements for successful handling of disruptive incidents are a combination of planning, procedures and training, focused on Prevention, Preparedness, Recovery and Evaluation.

- Managing incidents requires planning, staff training and clear procedures which are automatic and collaborative with external partners.
- Manage day-to-day incidents well and this gives confidence in staff and passengers who are much more concerned about this than major, irregular incidents. *“deal with small incidents well and you can avoid large incidents.”*
- Prevention – visible measures, staff presence, technological solutions (CCTV) – generating awareness of security measures can reduce incidents - deterrent
- Preparedness – clean systems and environments, staff training, procedures for escalating situations, practice disruption scenarios – planned ‘ad hoc’ measures.
- Recovery – if effective it builds staff, external partner and customer confidence, showing disruption has minimal effect, it is dependent on timely, accurate information provision and exchange.
- Evaluation – key role in informing future planning
- Shared responsibility in security is essential, but it generates vulnerabilities (ambiguities) if communication and planning is not clear or breaks down under stress.

Scale and disruption – when does a minor drama become a crisis?

As part of the SWOT exercise, participants were asked to explore the importance of time, space, and demographic in influencing the escalation of scale or severity of incidents. Here we discuss the issues raised by participants. The raw data is to be found in Annex 3, Q3.

Time of day/year

As noted above, time of day (and also the time of year due to changing daylight hours), are a particularly important factor in relation to the individual sense of personal security. Insecurity, in the form of a general anxiety, can be engendered by delays that impinge on responsibilities. Examples that were mentioned were being late for work or for business meetings, and in the evening, the anxiety that

is caused for people who have responsibilities to collect children from schools and childcare (where there can be very expensive penalties for late collection).

There are other reasons why transport delays, or fear of delay, will cause particular anxieties, for example, people travelling to medical appointments, particularly those involving hospital treatment. For the elderly travelling to medical appointments (or to visit hospital patients), these can be journeys which are outside their usual travel horizons, which naturally reduces confidence due to unfamiliarity (e.g. Pangbourne *et al* 2010). Indeed, participants noted that any person could become 'inexperienced' (and by implication less confident) simply by travelling at a different time of day or week than usual. Exploring this idea a little further around this notion suggests several reasons for this:

- Those who usually travel off peak are likely to find that peak hour travelling is disorienting because of the numbers travelling in the system at that time, the vast majority of whom will move at speed through interchanges, because they are habitual commuters.
- Those who usually travel on PT on weekdays may find that weekend schedules are less frequent, but may not have planned for this.

Some participants felt that winter delays were more 'serious' than delays in the summer. Two examples of this were elicited:

- Longer hours of darkness mean that the perception of when 'night' falls changes, and people feel more vulnerable at night.
- Excessive waiting times at unsheltered boarding points are uncomfortable (rural bus stops were mentioned, though small stations could also be relevant). Though not mentioned, the discomfort and unease of waiting in the cold could also have health and safety implications for the elderly and the very young. For the elderly in particular, the perceived risk from having to wait in the cold could reduce their travel horizons and effectively confine people in their homes.

However, summer heat can also cause delay or exacerbate the effects of delay for passengers (the example suggested was the experience of being stuck in an Underground system in hot weather).

These examples are mostly about personal crises. However, the time of day or seasonality also affects operations. For train operators, the autumn leaf fall can cause significant problems. This has become something of a staple for media and popular criticism of train operators (for example, the possible apocryphal passenger announcements about the 'wrong kind of leaves' or 'wrong kind of snow' causing delays are now in common usage). Train operators could be better at informing passengers about **why** this has such an impact on operations.

Though not mentioned by participants, accidents that occur during the hours of darkness are likely to take longer to recover from, thus the impact from relatively minor incidents could be greater than if they had occurred in daylight.

Type of area (e.g. rural/urban)

The level of impact of different types of geographical location on the experience of personal security experience was mentioned under time of day/season in relation to rural locations. However, there are also important geographic factors at play in reacting to and recovering from a disruptive incident, which can affect the size of the area affected, the numbers of passengers or operators affected, and the duration of the incident. We have used the brief comments made by participants to explore this issue in more detail. For example, geography matters in relation to the ability of the emergency services to access incidents. Participants did not give much explanatory detail, but common sense suggests that this is because of time taken to reach an incident (rurality being a particular factor here, though in the case of urban areas, getting through congestion to reach incidents could also be something that has to be taken into account).

Other location-specific factors relate to whether incidents are underground (depth of tunnels and age of infrastructure are factors as older tunnels for example are less likely to have emergency access and egress designed in), elevated (such as bridges) or otherwise difficult to access by parallel routes (for example incidents can occur on railway lines that are not near any road access).

These kinds of difficulties don't only make it hard for recovery teams (emergency services or engineers) to reach the incident, but can also make it hard to relieve stranded passengers, which increases the severity of the event and its consequences. For example, participants noted that in remoter areas of Cumbria and Scotland, the next nearest train on a single track route could be 30 miles away.

Given the number of public and private organizations involved in PT provision in the UK, this complexity plays a part in the geographic unevenness in information provision and disruption recovery. A particularly interesting observation that emerged during the SWOT exercise is that the UK transport system is becoming a three tier system consisting of London, large cities and rural areas, or even four tier, with London, large cities, larger towns and rural areas. This proposition is worth following up, to explore whether the experience of and recovery from disruption can or should be handled in different ways according to particular urban or geographic factors.

Demographic (e.g. age/gender)

Participants mentioned several demographic factors affecting the likelihood of disruptive escalation of incidents, mainly for the individual, rather than the operator. As noted above, the experience of peak-time passengers is quite different to other types of traveller, and they tend to react differently to disruption. To a certain extent regular travellers expect/tolerate some delay, though personal stress could build up over time. For the less experienced traveller, experiencing a particularly bad isolated incident could influence perceptions quite strongly.

Personal perceptions of risk are also affected by individual demographic factors – women and the elderly are likely to become more anxious if the disruption changes what should have been a daylight journey into a night-time journey and

arrival. Disabled people are also likely to find it more difficult to cope with disruption, as they may have particular accessibility needs in accessing or escaping from vehicles and infrastructure, or they may not be able to access information sources that could assist them to independently rearrange their journey.

Other factors affecting escalation

The raw data under this heading has been sorted into several distinct categories which are discussed below:

- Human behaviour: One factor that creates difficulties which magnify crises is the impact of social media in combination with mobile communication, as people can rapidly spread news of an incident and the nature of technologies such as Twitter encourages the sharing of all messages, including those which are incorrect or malicious. This topic is considered further under Threats below.
- Information availability: useable alternatives to disrupted services may exist close by, but as long as passengers do not know about them and thus can't switch route or mode, they remain an additional problem for the operator/authorities to deal with. The information vacuum is likely to be filled by the spread of peer-to-peer snippets via social media, in which the timeline of events is likely to be very muddled, further confusing passengers directly affected by disruption.
- Service characteristics: the impact of a small delay can be very great for those immediately affected if they have onward connections, leading to much greater time or cost implications for individuals, especially if ticketing is inflexible or the service they are connecting to is infrequent/unsubstitutable.
- Network characteristics: A second element regarding the escalation of minor incidents relates to network characteristics. For instance, even small events on high frequency lines can cause severe delays covering a much wider area of the network than might otherwise be the case if the incident had occurred in a less busy part of the network. Similarly, a series of small incidents close together in one place, particularly at a node, can quickly have impacts that spread outwards across various networks.
- Complexity and fragmentation: the high number of different organisations that might have a role to play in incident recovery requires coordination. A lack of coordination and non-alignment of interests can mean one service hindering another. The example given was of a fire at an Underground station, in which local bus services are disrupted by the fire service utilising the bus terminus area. The root of this issue is a lack of routine communication and resilience planning between stakeholders, as this leads to a lack of awareness by emergency services of the wider implications of the way in which incidents are handled. For instance, on main railway lines, a local fire and rescue service in charge of an incident in Milton Keynes could unwittingly cause transport impacts in London or as far away as Glasgow.

- Operator effects: poor decision-making by operators can result in the effects of a point event rippling out across the network. The example given was of a suicide in the Surbiton area, in which a TOC failed to stop sending trains into the area. This resulted in mass disruption, with the number of passengers doubling with every train load, stuck trains overheating and some passengers acting rashly in the absence of information by attempting to force doors in order to exit trains, even between stations.
- Regulated incidents: for certain types of incident (such as fatalities or hazardous materials) there are specific protocols that must be followed by law, in which control and responsibility for the situation is passed to particular authorities. This can lead to significant disruption. These observations are supported by presentations given at the Transport Security Expo and Conference (Transec 2012) on 14th and 15th November 2012 (e.g. Higgins, 2012).
- External factors: events in other regions within a country, or in other countries, can heighten awareness and 'jumpiness'. For instance, a terrorist event in one location can result in a higher state of alert. This can lead to quite small events causing public panic or having greater control put over them by the emergency services.

Whilst not strictly 'escalation' of a specific incident, it is well-known that the incidence of certain sources of disruption temporarily increases as a result of the 'copycat effect'. Participants mentioned how some types of tragic incidents, such as suicides, can lead to a spate of similar incidents. A similar replication effect is seen with crime (e.g. cable theft – an issue highlighted at Transec 2012), and there are often many hoax bomb threats in the aftermath of a real incident.

Strengths and Weaknesses

Strengths	Weaknesses
<ul style="list-style-type: none"> • Planned events and routine incidents • Many interchanges and hubs provide information backed up by visible staff presence • We know how to do saturation public and proactive press messaging • Management commitment and presence during disruption is helpful where practiced (and planned for) • Seasoned travellers are resilient, cope well with disruption and adapt their plans independently • New mobile technologies are capable of substituting for costly information displays • Social media and mobile innovations have been rapid, particularly where open data can be utilized 	<ul style="list-style-type: none"> • Keeping operator-provided information dynamic and up-to-date • Geographic variability in quality of information provision generally and in cross-operator coordination during disruption • Inconsistent message still prevalent, both across modes and across information provision channels (even using same source data) • Good mobile phone and broadband connections are not universal, hampering the effectiveness of information provision on the move • On-vehicle information can be sparse, poorly designed or inaudible and vehicle staff often don't know what is happening • Interchange and boarding point information is very variable • Lack of inter-operability of RTI systems across railway stations (66 different systems) • Not communicating the underlying cause damages relationship with PT users • Low levels of public knowledge about information sources • Giving front-line staff the resources they need to provide reliable information to anxious passengers • Commercial considerations create barriers to close collaboration • Emergencies and disruption with external cause can quickly escalate and become more serious • Commercial operators regard disruption information as 'bad PR'

Figure 2 Strengths and Weaknesses in Current Provision for Disruption

Strengths were identified in terms of the ability to cope with planned events and the more routine disruptive occurrences, when preparation has been properly resourced. This is evidenced from public feedback, and from operational/event

debriefings, and it demonstrates that good procedures and supportive information promote positive customer perceptions. However, the reassurance of human presence is expensive - often only deployed on planned [event] or 'emergency' scenarios, with commercial considerations driving down staff presence as far as practical for 'normal running'. The trend for senior management to come out of their offices and interface with the public during a crisis is clearly a recognition that authoritative human presence in times of uncertainty is important. However, participants also clearly recognized that there is also a weakness in current practice, as senior management risk reputational damage if they are insufficiently informed about the front-line environment and the disruption recovery actions that they are ultimately responsible for.

Flash flooding in Newcastle, Autumn 2012

One participant noted that the "Toon Floods" over the summer had a massive impact on the local transport network, which started to fall apart. However, a major crisis was averted as all operators managed to work cooperatively. However, this coordination was regarded by the participant as anomalous.

A websearch for information on the 'Toon Floods' unearthed a blog which gives some audio information about the authorities' response to the flooding: <http://fionamarleypaterson.com/2012/08/07/newcastles-flood-control-room/> (accessed 30/1/2013). Another link found was to an appeal from Newcastle City Council for citizen feedback on their experiences of the flood and the response to it: <http://www.newcastle.gov.uk/news-story/council-seeks-feedback-after-%E2%80%98toon-floods%E2%80%99> (accessed 30/1/2013). What is interesting about this item is that the list of participating organisations (though not necessarily complete) does not mention any transport providers, although the city council itself is a transport authority.

Opinions differed about the development of the balance between dependence on technology, staff, or human instinct in coping with disruption. Some were optimistic that personal interaction with mobile information provision would create self-sufficient PT users, whereas others felt that the reassurance of a human presence would always be a better support for security, safety and confidence during travel uncertainty and disruption. Clearly passengers are not homogenous. Some are well-informed and resourceful, especially seasoned travellers, whereas others vary in terms of experience at PT travel, using IT, using information or simply at planning ahead. A one-size-fits-all approach to meeting passenger requirements for information and support during disruption is unlikely to be satisfactory.

Some general principals around information provision were identified, particularly in relation to clarity about what type of information is being conveyed, and when it is given. Passengers require information about disruption to their journey, not what is happening to the network, and therefore personalised and timely information is best. For many fast-moving situations, information is out of date after 5 minutes. Front-line staff do not often have the information they or the passenger needs for accurate advice. The fragmented

nature of the transport system also means that front-line staff have no idea about potential options that involve other operators. Whilst many passengers are not knowledgeable about the range of information sources available, and fall back on face-to-face or telephone enquiry, from the perspective of those who do know something about the multiple potential sources of data, how should they interpret and assess their relevance in different circumstances?

A key criteria for information is that it should be useful as well as factual. One example that was given regarding typical disruption information involved Canary Wharf station. This station sometimes has to be closed for safety reasons because of over-crowding. The information that is given out is that the station is closed, which is factually true. However, what should passengers do in this situation – wait until it reopens or find another route? In the example, the delays at the station were caused by a signalling problem at another station, and the method of resolution is known to take 40 minutes. Honesty in information is important to enable people to cope, and people could have been given information about the cause of the problem (technical failure elsewhere), the reasons for the closure (safety), and the likely duration of the disruption. This would have enabled those intending to use Canary Wharf station to make their own decisions about whether to wait for service resumption, or to alter their transport route or mode.

These principals can be organised into a passenger-centric mnemonic for those responsible for disseminating disruption information: AUTHOR. This acronym is explained in the matrix below.

Accurate	Information must be factually accurate. If there is uncertainty about a situation, ideally the information given out should say so.
Understandable	The message should be brief and to the point, so that it is quickly apparent what type of information is being given out. However, the language used must also be easy for passengers.
Timely	Disruption information can go out of date quickly as the situation changes. Operators and information providers should be committed to updating the information as often as necessary for passenger reassurance and trust.
Helpful	The information that is provided must make it possible for passengers to decide what to do – whether that is to wait patiently where they are, delay or cancel their journey or find another route or mode in order to reach their ultimate destination.
Open	The information should be honest, and not hide behind euphemisms or jargon.
Relevant	Passengers need to be able to readily understand how the information applies to them, and to their journey, rather than being a general message about delays on ‘the network’ (for example).

Disruption information that meets these standards can then contribute to a positive perception about recovery from disruption in the minds of staff, external partners and customers which in turn increases confidence in travel (a point that is reinforced by Kritzer, 2012). However, information provision is subject to operational constraints for example when first responders are in charge. There is no single model that will work in all situations – there will be trade-offs. This is an ideal from the passenger perspective.

Opportunities and Threats

There is currently a great opportunity to evaluate how we use technology in the transport environment, particularly in relation to handling disruption. how we use it. IT-based information provision is primarily targeting (intentionally or not) the ‘seasoned traveller’, but is less good for the many other types of passenger, who are consequently less able to negotiate disruption independently. Rapid social media developments are leading to passengers being ‘better informed’ than staff because staff information systems and equipment are not state-of-the-art and there is a lack of institutional trust in them. This creates a lack of trust in official sources of information in situations that are rapidly changing. Operators and authorities need to learn to take account of the ‘viral’ spreading of good AND bad information via social media. However, there are resource implications for operators in adopting good social media practices and also a need for a well-informed strategy supported by experienced staff with good judgement.

Opportunities	Threats
<ul style="list-style-type: none"> ○ The data source explosion, including crowd-sourced and location-based disruption information ○ Increased understanding developing from experimentation with new technologies and social media ○ The ‘Olympic Legacy’ ○ Greater awareness of the role of ‘design’ to inform good solutions ○ Light-touch securitisation could be achieved through quicker biometrics ○ Technology-enabled cross-operator/provider coordination and information-sharing ○ New rolling stock and vehicles with improved safety and better IT and communications systems ○ Better on-vehicle telemetrics, including GPS for better RTI, loading and passenger number data, could provide opportunities 	<ul style="list-style-type: none"> ○ Complacency ○ Failure to exploit the ‘Olympic Legacy’ ○ Economic environment continues, reducing human resource capacity and damaging investment and renewal ○ Failure to recognize current technological opportunity where senior management are ‘late adopters’ ○ Over-reliance on technology (which could itself be disrupted or inaccessible to staff or passengers) ○ Business drivers over-ride user need ○ Malicious or criminal use of social media (and other technologies) ○ Complacency amongst users and stakeholders about social media, which must be utilised professionally and with maturity ○ Failure to recognise the advantages of social media and other new

<p>to support schedule adaptation, RTI, emergency decision-making and passenger demand management</p> <ul style="list-style-type: none"> ○ New demographic for technologically 'savvy' ○ Integrated ticketing linked to real time personalized travel and disruption information ○ Ability to easily share data offers opportunities to better coordinate between operators and with support/emergency services through central hubs ○ All railway stations should have live RTI. Centralisation and harmonisation of rail RTI is needed. ○ Build on knowledge base about disruption events to suggest a range of 'solutions' to passengers 	<p>technologies</p> <ul style="list-style-type: none"> ○ Poor use of social media by operators ○ Failure to recognise the role for good design principals in the built and information environments ○ The ageing demographic leads to loss of knowledge from transport industry ○ Commercial protectionism about data and platform-sharing (e.g. Smartcards) prevents co-operation and coordination
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Figure 3 Opportunities and Threats

Some important questions were raised during the identification of opportunities and threats, particularly in relation to how much information should be given out publicly. For example, is there a risk that in certain, potentially critical or life-threatening situations, too much passenger information could create further panic/annoyance/frustration?

In regard to data availability, opportunities were perceived around the Open Data movement, specifically around Open Linked Data, which provides better quality data for automation. However, the highly commercial nature of the transport environment means that business interests are likely to over-ride user need and technology innovation could be constrained as a result. Smartcard developments were cited as an example, as it is both possible and efficient to 'share' a chip so that users could have a single card for ticketing, workplace access, leisure and other public services access (e.g. school dinners, benefits, sports centres and libraries), as well as banking and payments. However, companies are often not keen to share data platforms and carriers such as electronic cards by having other providers have an identity on it. This could be for security, reputational and brand recognition reasons. It is also possible that consumers will perceive dependence on a single card as personally risky, in spite of the simplification that it introduces.

Social media was perceived in two diametrically opposed ways: as a threat and as an opportunity. Whilst some operators are making innovative and valuable use of the new technology (as noted in Work Package 1), others have a 'head in the sand' approach, merely 'monitoring' it, or ignoring it entirely, regarding it as an irrelevance at best and as a threat at worst. There are clearly degrees of engagement: ignore, monitor but not engage, limited engagement, high

engagement. Each has benefits and disbenefits with reputational risk at stake, and the resources to support engagement are also an issue. It was also noted that senior management tend to lack knowledge about new technologies and social media movements. There is a tendency to put junior staff onto social media tasks **because** they are young and 'clued-up' without realising the strategic risk. Without judgement, high level strategic thinking and adequate resourcing, the well-intentioned, but erroneous use of social media becomes a threat, as there will be issues about who 'controls' the message e.g. citizen journalists versus transport operators/authorities, as this could influence how the impacts of disruption evolve. Whilst this is clearly a current weakness, it remains a threat as the immediacy and accessibility of communications will only increase.

Another double-edged sword that was identified is the perceived threat posed by 'Big Brother' society. The UK already has one of the highest levels of CCTV presence in the world. Whilst with the advent of CCTV analytics, higher levels of CCTV coverage could offer benefits, there would also be a significant privacy trade-offs. Similarly with other market-present technologies that provide locative and tracking capability, such as GPS or Bluetooth, the personal and societal benefits of intensifying their use in the transport domain need to be carefully balanced against the privacy concerns.

The 'Olympic Legacy'

As noted above, several participants had recent experience of the unusual level of preparedness and investment that went into the London 2012 Olympics. The oft-quoted 'Olympic Legacy' is perceived national as a critical opportunity for change, not least in the PT sector. The main opportunities identified by participants are shown in the figure below.

The Olympic Legacy opportunities for transport
<p>Coordination of messaging is the key as the public need to have a consistent approach.</p> <ul style="list-style-type: none"> • The Olympic Transport Coordination Centre achieved consistent messaging across operators agreed in 2 mins instead of 25 mins <ul style="list-style-type: none"> ○ The potential to build on this is dependent on where you are in the country and how deregulated the transport system is • TCC learned from the experience of inconsistent messages between different operators at London Bridge during Jubilee-related disruption <p>Techniques</p> <ul style="list-style-type: none"> • Saturation messaging, adding information that people want (such as British Gold medal wins), not just 'boring' travel information, makes people have a reason to pay attention to the signs. <p>Media strategy</p> <ul style="list-style-type: none"> • The Olympics was to adopt proactive press messaging. <ul style="list-style-type: none"> ○ Media had free access to TCC, including filming. 'nothing to hide' ○ Proactive media messaging allows 'hiccup' to be accurately reported and not become a scare story <p>Planning</p> <ul style="list-style-type: none"> • Olympic transport planning was focused on mass movements, not the

personal security of individuals, though planning did account for the implementation of Security measures to reduce disruption if necessary.

- To help individuals, back-office staff were rolled out as 'Travel Ambassadors' and issued with iPads to help individuals face-to-face. The iPads were linked to all the information they required, to reduce the need for expert knowledge

Figure 4 The 'Olympic Legacy' opportunities for transport

Some workshop participants considered some of the strategies that were adopted during the Olympics as 'impossible' to implement in normal practice elsewhere. The issuing of iPads to Travel Ambassadors was one solution that was viewed as such. The underlying reason for this was not clear, but analysis suggests that organizational culture and trust are likely to have a role here.

STEEP(L) Analysis

In this exercise, participants were asked to identify key driving forces that will affect the causes, frequency or severity of disruption and its impacts beyond a 5 year horizon. This is intended to help participants move from a concern with current issues, to a forward look grounded in their experience and knowledge. The raw data collected from the Innovation Centre software can be found in Annex 4. Here we have collated and summarized the data into two tables, one for Social, Technological and Environmental driving forces, and one for Economic, Political and Legislative/Regulatory driving forces. In this analysis of the workshop data, we have used our own academic knowledge to expand logically on each point.

Social, Technological and Environmental Driving Forces

The summarized data is found in Figure 5 below.

Social Driving Forces: participants considered that demographic changes, such as the well-documented ageing of societies taking place in developed nations, would increase the numbers of people dependent on 'public transport' services, as there would be a lower base of wage earners, and in real terms salaries would be lower than they are now. Furthermore, an ageing society will lead to an increase in people who are not allowed to drive for health and safety reasons (e.g. certain types of medication or vision problems). There could be an increase in exclusion from mobility on price grounds, and this could contribute to social unrest. The increased dependence on PT and the rise in the population (driven by migration) will result in disruptive incidents tending to affect many more people than at present. However, participants were not sure whether there would be more public resignation in the face of disruption and congestion, or whether it would be seen as unacceptable. However, as those who can afford it will also want a more seamless travel experience, there is likely to be a significant segment of society who complain vociferously about disruption and congestion if it interferes with their other commitments. The increase in migration to the UK will also lead to a requirement for information to be available in more languages.

Migration forecasts for the UK have been revised upwards consistently since the 1990s. Cangiano (2012) suggests that the UK population could be 75million by 2035, with high net migration, and 71 million by the same date with low net migration. The central scenario suggests 73 million by that date, an increase of 18% on 2010 levels. Net migration accounts for more than 60% of this increase. There are important geographical variations – Scotland, for example, is projected to have a stagnating or declining population without net migration.

Whilst there are no current official projections for different ethnic groups, Coleman (2010) has used data that is routinely collected on ethnic group (which has become standardised around 16 groups, that breaks “white British” down into sub-categories), to devise projections out to 2056. Coleman has combined some groups to reduce the ethnic groupings to 12. Therefore, information and support potentially needs to be made available in forms and languages that meet the needs of 12 ethnic groupings.

New ‘alternative lifestyle’ communities are likely to appear, some in urban areas and some in rural areas, which will either seek to reduce overall mobility amongst their members, or to control their own cooperative transport services. For example, the growth of alternative lifestyle communities could come about through continued spread of the transition movement (www.transitionnetwork.org) that has been growing steadily around the world. This aims to support grassroots, locally-based initiatives to make communities more sustainable and resilient against energy and climate shocks.

Technological Driving Forces: Participants identified a number of constraining as well as enabling driving forces. For example, a rapid increase in intelligent transport systems and services could be constrained by bandwidth supply for data transmission. Transport uses of bandwidth are unlikely to be able to compete commercially with large media companies who are also seeking more capacity. Power supply, for vehicles and also for mobile communications, is likely to be a critical constraint. New vehicle fuel technologies such as hydrogen require new ancillary infrastructures that could be costly and time-consuming to construct, as they would require to go through the planning system (e.g. new vehicle depots are needed for hydrogen vehicles as they need to meet a quite different safety standard than conventional vehicles; new fuelling infrastructure is also essential for wide-scale uptake). Congestion, or more intensive use of networks will have implications for maintenance: both work-load capacity and basic resourcing. Some technological advances in data processing will be needed, technology is likely to be more ubiquitous.

Environmental Driving Forces: The primary driving force under this heading was identified as climatic – with increasing disruption from extreme weather events. Ageing infrastructure was identified as particularly vulnerable. However, under this heading participants also identified factors that should more properly be seen as interactions between driving forces. Firstly the interaction of environmental driving forces and social driving forces will lead to a change in environmental attitudes (this builds on the environmental education that has

been delivered in schools in previous decades). A green agenda, and the carbon content of travel, are likely to be a particular public focus that transport providers will have to respond to. Similarly, the key environmental resource of energy (particularly fossil fuels) will become constrained quite apart from the carbon reduction agenda, and unlocking more renewable sources of energy will depend on the technological driving forces (as well as social and political driving forces in terms of acceptability and will). Shortages would lead to disruption. A final factor was identified of cosmic events such as solar flares, having a catastrophic impact on satellite communications systems. Whilst this might be a low probability event, the impact is potentially very severe and large scale (Bhasin and Bardhan, 2012).

Economic, Political and Legislative/Regulatory Driving Forces

The summarized data is found in Figure 6 below.

Economic Driving Forces: Participants noted that the cost of infrastructure maintenance and upgrading would lead to an increased vulnerability to disruption. Here the economic driving force interacts with the political driving force, as will and leadership is needed to find and commit resources for big infrastructure projects. It was also noted that there is a tendency only to fund really major projects, and that the costs of consultation greatly increase the time and risk involved. In terms of other interactions, there are effects from multi-level governance, with EU, global and local economies and politics affecting how decision-making proceeds at national level. Economic drivers could substantially change the shape of PT provision, by knocking out scheduled services which are not economically viable. Services in rural areas would be particularly vulnerable, and disruption to private transport could have severe effects anywhere where scheduled PT provision has been withdrawn. However, this leaves a niche for flexible transport provision to exploit, and technological advances are likely to be very useful in enabling these kinds of services to reach more people. Another potential benefit to passengers is that a reduction in the total number of operators could make the coordination of services and information much easier.

Social	Technological	Environmental
<ul style="list-style-type: none"> • Greater dependence upon PT –fewer and lower wage earners (inc. the young and old), who cannot afford or are not allowed to drive • The very poorest will be excluded from PT on price grounds and social unrest will increase • More people will be affected by each disruption • Rise of alternative living communities - move from city to rural or vice versa • Requirement for multi languages • Societal desire for seamless travel • What will the public attitude to congestion and disruption be – more or less acceptance? 	<ul style="list-style-type: none"> • Bandwidth for data transmission could be a constraint: transport is poor relation, but it needs bandwidth for operations yet leisure and entertainment companies have deeper pockets • Power supply, particularly batteries and alternative vehicle fuels are a critical constraint • More intense use of existing networks - can maintenance and supply keep up with demand? • New transport techs come with infrastructure issues i.e. Hydrogenbuses need new bespoke garages and fuelling points. The old infrastructure often cannot be adapted • In-memory processing of data - process mass data from multiple sources much more rapidly • ubiquitous technology • Standardisation between systems is needed to ensure continuity 	<ul style="list-style-type: none"> • Extreme weather events are increasing in frequency and climate change theory suggests this will continue • People will align to the green agenda and transport operators will have to respond. Initial focus likely to be the carbon impacts of journey • Energy availability will change pushing moves to renewables/alternatives to fossil fuels and the infrastructure required to support it • Disruption caused by energy shortages/supply problems • Infrastructures vulnerable to weather, esp. ageing • Solar flare might knock out all GPS and radio comms

Figure 5 Social, technological and environmental key driving forces affecting the evolution of transport disruption

Economic	Political	Legislative/Regulatory
<ul style="list-style-type: none"> • Maintenance of infrastructure is costly and failure to upgrade mean vulnerability to disruption increases • Funding availability /appetite for big infrastructure projects • Mainly big projects funded - cost of consultation • Will PT services look the same in future? Services which are not economically viable may change/disappear e.g. DRT replaces scheduled PT. • EU, global or local economies - what will influence UK decision making or will it be done for us - and others? • Rural PT services are vulnerable - how cope with disruption if there are no alternatives? • Overall reduction in number of operators may make things easier for coordinated information 	<ul style="list-style-type: none"> • Increased instability of political structures - transport interventions are long-term 'things' yet politics works on the quick win, short-term delivery whilst in power • Conflict of interests between Local vs. Regional vs. National vs. International political agendas constrain achieving consensus on common interests • Political 'silos' don't talk between departments • Key lobbies may agree on the problem but fail to align on the solution (e.g. improved transport capacity in SE UK) • Increased tensions re <i>per capita</i> transport spending between London/SE and rest of UK • Hacking culture and who has ownership of data become major political issues, affecting international relations • Desire for more regulation of buses • Possible nationalisation or creation of monopoly franchise for all London Rail 	<ul style="list-style-type: none"> • The direction of regulation will be governed by whether economic growth trumps the carbon agenda • Legislation will/may change due to global and/or domestic incidents - unknown at time- but impact will occur • More Quality Contracts for bus operations • Increasing customer expectations will drive legislation for more stringent performance monitoring of services during disruption • The current uncertainty over rail franchising will have political implications - process will need to be completely redesigned • Trajectory of Regulatory regime for buses will influence development of bus networks over the long term (e.g. in London decisions about new Bus for London will remain in force until about 2025 before change can occur)

Figure 6 Economic, political and legislative/regulatory key driving forces affecting the evolution of transport disruption

Political Driving Forces: Participants felt that there are considerable conflicts of interest between different scales of political activity, which could increasingly constrain the achievement consensus on common interests or around passenger benefit. Agreement on problems is often found, but progress is stalled by political disagreements about appropriate solutions. Political 'silos' will continue to hamper 'joined up' thinking. Similarly, political structures are likely to be increasingly unstable, making it harder to achieve major change in transport infrastructure as timescales are long-term in a political environment which operates on a 'quick win' basis, looking for short-term delivery over truncated periods in power. In the medium to long term, the 'success' of the London/South East region of the UK could deepen tensions with the rest of the country as the SE sucks in most of the constrained funding which is tied to projects which underpin 'economic growth'. A contrary political tendency could emerge simultaneously which leads to a degree of re-regulation of bus services and the creation of a monopoly franchise for all London rail services, though this might not be replicated in other metropolitan areas.

Legislative/Regulatory Driving Forces: Overall, participants felt that the direction of regulation would be governed by the relative political balance between the economic growth agenda and the carbon agenda. However, some legislative/regulatory change could be stimulated by as yet unknowable global or domestic incidents (whether safety, climate or terrorism related). In the meantime, more Quality Contracts would probably emerge for bus operations, and customer expectations would drive legislation for more stringent performance monitoring of services during disruption, as well as during normal service. Some administrative scandals could affect the development of transport, for example, the current uncertainty over rail-franchising caused by a lack of standards in the DfT will have political implications, and the process will need to be completely redesigned. The outcome of the resultant changes will not be fully reflected in the rail network until the medium term. Similarly, long lead in times for some changes in the regulatory regime for buses will affect that network over the longer term (e.g. the decisions regarding the new Bus for London will affect the vehicle fleet until about 2025).

The Scenarios Exercise

Participants were given the framework for the scenarios exercise, which is based on those produced by Berkhout and Hertin (2002). The full rationale for the choice of this framework can be found in Work Package 1 Report (Pangbourne and Beecroft, 2012). The over-arching framework is illustrated in Figure 7 below.

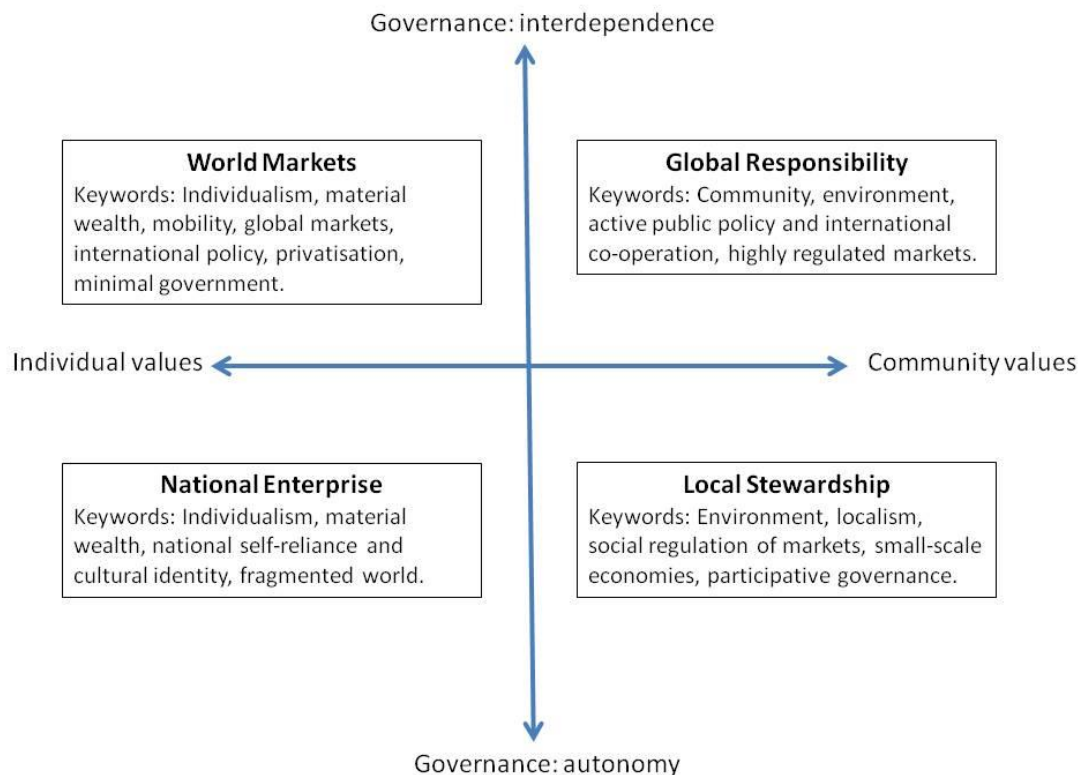


Figure 7 Scenarios Exercise Framework (Source: summarised from Berkhout and Hertin, 2002)

As the workshop was following on from the first workshop, which explored the provision of PT travel information in general, it was decided that the scenario narratives about the four plausible futures would be helpful to participants in narrowing down on the causes and responses to disruption. Therefore, all participants were given the longer narratives produced in Work Package 1 (see Annex 5). As with the first workshop, participants were divided into two groups, and each group considered a diagonally opposite pair of scenarios. Group 1 considered World Markets and Local Stewardship, and Group 2 considered Global Responsibility and National Enterprise. Mark Beecroft facilitated World Markets and National Enterprise and Kate Pangbourne facilitated Global Responsibility and Local Stewardship (i.e. swapping groups at the mid-point of the session).

Questions for scenario development

The response to disruption is dependent on context: both type of incident and scale will affect the level of response by operators and authorities as well as passenger reactions and expectations. The task for participants is to consider how uncertainty and disruption are handled within the context of the four alternative scenarios. We are particularly interested in how public transport information will develop in different ways under the four alternative scenarios, focusing on impacts on passenger uncertainty, particularly during disruption, with particular reference to issues of personal security.

Each group were asked to consider the questions below in light of the information they were given about the type of world envisaged under each scenario (i.e. the narratives produced in Work Package 1). Discussions were captured using whiteboards, and have been used to develop the original scenario narratives to include disruption and uncertainty. The questions posed to participants, to help them focus their scenario development, were:

- Under this scenario, what types of disruption will be most prevalent, and over what scale will they occur?
- From a passenger perspective – how will travellers react to disruption as it unfolds, and what will be their expectations of support in terms of information and services during disruption under this scenario?
- From the operator perspective – how will operator response be regulated or policed, how will they seek to resolve problems, handle immediate impacts and return to normality, and will information to passengers be a priority?
- What will be the threats to personal security in disrupted travel under this scenario?
- What will be the solutions to these threats generated under this scenario?

World Markets

In this scenario, participants felt that the divided nature of society would lead to polarization with consequent social disorder ranging from legal activity in the form of civil and industrial unrest (e.g. mass protests and strikes) to criminal activity (e.g. rioting and criminal damage) as commonplace causes of disruption. The decline of public transport services resulting from intense commercial pressures would see industrial relations in the sector deteriorate making the transport system itself a focus for disruption (e.g. strikes, work to rule, etc.). The commercial pressures in the sector would lead to cost-cutting wherever possible, leading to declining investment in maintenance of vehicles and infrastructure resulting in major accidents on networks leading to further significant disruption. Reliance on the market means that when commercial failures of transport services occur the Government does not step in to provide services, worsening disruption when services withdrawn.

The high level of mobility characterized by international and domestic long distance travel with complex journey patterns mean that small disruptions can have significant knock-on effects and cause major disruption for travellers (the domino effect). The enduring popularity of the private car means that congestion on road networks will be regular but predictable.

The prominent role of Multi National Corporations in this society will cause resentment and opposition. They will be the focus for terrorist activity upon transport infrastructure, services and the underpinning IT, involving both highly mobile international groups and willing local recruits discontented with the prevailing polarization of society.

Customers paying for high quality transport services will expect high levels of service during disruption with bespoke solutions. They will expect highly interactive services with dynamic information exchange to mitigate and resolve disruption effects. Passengers will be very risk averse and pay high costs for preventative services. Commercial Demand Responsive Transport (DRT) services, taxis and hire cars will support contingency planning during disruption. Passengers without the means to pay will expect high levels of disruption and adapt to them. However, effective self organisation strategies will be difficult to achieve due to lack of freely available quality information. Disruption will reduce confidence in travel, compounding trends towards lower travel horizons.

Commercial competition in services, absence of government regulation and the lack of open data are major barriers to cooperation between service providers during disruption and there is even technical incompatibility of services to provide mitigation. Operators will be very risk averse and pay high costs for preventative services looking to invest in whole-journey solutions which integrate cross modal services to provide resilience during disruption including the car e.g. hire, taxi and park & ride facilities. This will include highly dynamic, predictive journey planning that integrates the car e.g. Sat-Nav streams in PT information when disruption occurs. The need to maintain passenger loyalty will make quality passenger information a top priority. The commercialization of law and order services will mean that private security operators work with transport service providers and costly Police Service Agreements to support events and travel generators will be commonplace.

Perhaps the most significant threat to personal security will be the lack of societal cooperation resulting from the absence of a sense of community (except amongst trusted groups) which will make people reluctant to support others at times of disruption. Social disorder will threaten individuals and property, times and destinations of travel will be highly significant. As crime and anti social behaviour is displaced to peripheral areas there will be 'no go areas' which vary by time of day.

Disruption in the technological domain will result in personal data theft or loss and corruption including identity, location and journey data. Vehicles will also be vulnerable as they are often automated and remotely accessible and cooperate with infrastructure/other vehicles, all of which causes significant vulnerability to system failures and malicious acts.

The response to these threats will be variable. Reputational risk will be the key driver in solving security issues and if threats affect customer confidence and ultimately revenue then operators will invest highly in security measures. If not, risk management strategies will be deployed. This investment will see the Operators' 'Owned spaces' being well maintained and safe, but problems will be encountered at the boundaries with unmanaged environments. The domino effect (see above) will be mitigated by operators taking a logistics-style approach to manage the whole supply chain with dynamic contingency planning services incorporated into journey planning services.

The response to terrorism will be driven by MNCs who are the main targets. They will invest heavily in prevention and protection of key assets, target hardening and designing out terrorism will drive technology and policy development. Again, this will contribute to displacement of criminal activity and a high degree of variability in standards and services being encountered during travel across boundaries/jurisdictions.

Global Responsibility

In this world, participants felt that the primary causes of infrastructure failure would be abnormal events, particularly large scale weather-related problems caused by high winds and flooding. Longer term changes caused by climate change, such as sea-level change, will have been planned for and effectively mitigated across the transport network. Other causes of wide-scale infrastructure failure were most likely to be human error or cyber attack. More localized disruptions would come from unpredictable or late predictions of spikes in demand. One source of this would be mildly bad weather driving the large active travel demographic onto the PT network. Another source would be the rise in flexible working practices, making the 'rush hour' a fuzzier and less regimented concept than in the present day.

The cooperative nature of society and the flat, consensus-based organizational structures could be quite bureaucratic, making some decision-making slow. However, this tendency would be countered by the emphasis on planning and preparedness, as corporate social responsibility is taken very seriously. Operators who had poor disruption track records would be publicly challenged. Therefore disruptive incidents would have a reduced tendency to escalate as containment would be achieved more quickly by isolating problems from the wider system and adopting fully integrated disruption resolution procedures. Whilst some people might experience severe disruption, the majority would suffer only minor inconvenience. Participants described this as a 'self-healing system'. In part this development has been driven by the changing perception of time that has come with the flexible working practices enjoyed in this society. 'Routine' disruption is less easily tolerated, because it has become rare as the network is well-resourced with public money in a highly democratic political environment.

The flexible working practices and good IT communications have enabled many people with the resources to move out from urban centres to rural areas, which are much more expensive than cities, for 'lifestyle' reasons. The government attempts to counter this through regenerating urban centres, which have become more 'liveable' through changes to building and street architecture, being more conducive to active travel and for the ageing demographic, better street lighting for example supports personal security 24/7. These urban escapees are no longer burdened by the need to commute, and transport for many people has become something for leisure and recreation, particularly visiting friends and family, rather than for work. Group leisure travel has increased markedly. Ownership of private vehicles is down, but personal low-carbon vehicles still feature, on a new model of shared ownership and casual access, similar to today's car clubs and bike hire schemes. The personal security impacts of

disruption on longer trips is increased, as the time involved in making them is highly valued when such trips have become rare, making travellers less 'seasoned'. However, the community-oriented nature of society enables individuals to cope well as they feel supported during adversity, even by strangers.

Nevertheless, there are some pressures on this society, as the impacts of climate change are felt on global food production. Agricultural failures in some regions drive immigration to this society, mainly to the cheap metropolitan areas, further fuelling the 'urban escapee' movement. Some migrants may be a source of the disruptive radicals that pop up from time to time in this society, who may wish to cause loss of life or injury, but are also likely to engage in cyber attacks, in which loosely-affiliated extremist hackers target critical infrastructure. The highly automated nature of policing and transport, and the dependence on telecommunications means that successful attacks would have wide impacts, through a domino effect potentially causing a catastrophic nation-wide systemic failure.

Local Stewardship

In this world participants felt that the emphasis on active travel and local journeys would lead to high levels of localization congestion and safety issues between cyclists and PT vehicles such as trams (for example, bicycle wheels becoming wedged in tram tracks). Thus the greatest threat to personal security would be to physical safety as a result of accidents, though the resultant delays would also damage confidence. This would drive attempts to promote physical separation between traffic types, and shared space developments would be reversed. The high levels of active travel also means that mobility will be disrupted by the weather, and even normal winter weather will limit travel, with particular problems of personal isolation on the winter.

Confidence to travel any distance is lost, as crossing boundaries is difficult – the privatized nature of PT means that there is no integrated ticketing and information provision has become parochial. Smartcards failed to develop, and real time disruption information is lacking as the business case for it is weak. Only very wealthy people have broader travel horizons, and can pay for the bespoke information services to support their greater mobility.

The emphasis on localism will lead to considerable fragmentation across national space of politics and economic investment. The loss of economies of scale will lead to infrastructure problems, as standards diverge. The rise in individual power through elected roles such as Mayors and Police and Crime Commissioners will lead to great unevenness, and to outsiders the country might look like an uneasy collection of 'medieval fiefdoms' and local/regional rivalries. A weakening of investment in PT infrastructure risks a rise in safety-related failures that trigger a cascade of negative impacts reaching into other sectors, and fuelling competition between locales, as companies could seek to relocate to regions with better infrastructure.

National resilience is weak due to lack of coordination and cross-boundary rivalries. The small economies are vulnerable the impacts of disruption and crisis incidents, as mutual aid of emergency services across political and administrative boundaries is weaker than in the present day. Silo-based thinking progressively restricts the capacity for multi-agency co-operation as they increasingly use different systems and follow different working practices. However, procurement choice narrows, so that could counter the effect to some extent, as there is a narrower choice of equipment from which to select.

There are few national security effects as the fragmented and localized politics leaves little to target at the national level. The disaffected are thus focused at the local level, which has become highly politicised, and factions could develop which are polarized between 'micro-nationalists' seeking to maintain and deepen localism through separatism and national re-integrationists. In smaller communities these groups are dependent on approval from their communities and do not seek loss of life. Instead they target hard infrastructure to cause disruption and gain publicity to foment civil unrest. Bus depots and railway yards and sidings become key targets, and the groups clash with each other (similar to the situation in Northern Ireland in the 20th Century).

Whilst society is community-oriented, the communities that form are polarized within these smaller political units, oriented towards one faction or another. Personal support in times of disruption would then come from those in the same faction rather than from anybody, though there would be many neighbourhood-watch style organizations, and volunteer police wardens, offering support to the needy (a current forerunner of this style of operation might come from Hamas in the West Bank and Gaza), and providing social control. Fare evasion and low-level anti-social behaviour is suppressed by this. Most crime is petty, with cycle theft a particular problem. Large-scale organized crime is relatively rare.

In this environment, operators respond to the security threat by employing private security guards and installing security measures at their key assets. The PT industry is organized into franchised services for key routes or key client communities and they are subject to politically motivated local regulations. Levels of information provision are built into service agreements and they do not innovate outside that unless there is a business case. Operators protect against serious disruption by having business continuity plans.

National Enterprise

In a society where homeland security and the protection of critical national infrastructure will be the highest priority, travel on those networks will be largely safe and secure with limited disruption. However, national insularity and the lack of international cooperation mean that terrorism, international sabotage and cyber attacks are constant threats and very occasionally major incidents will occur causing significant disruption. The investment required to secure critical networks will be a massive drain on resources which means that infrastructure and services on non-critical routes suffer from underinvestment resulting in commonplace disruption caused by system/infrastructure failures.

The high degree of social polarity will result in disorder with civil and industrial unrest, crime (particularly theft) and anti-social behaviour being major problems. However, there will be considerable spatial variability with critical infrastructure and major cities being viewed as safe spaces, whilst more marginal areas are encountered with much higher risk. The dominance of the car means traffic congestion is regular and expected, but those with ability to pay can mitigate the effects by accessing premium lanes offering improved journey times.

Fragmentation of transport services and intense competition means small margins for operators, common commercial failure and service disruption. However there is a safety net of government provision in relation to key routes and services when commercial services are withdrawn, but only to support the operation of major networks.

Energy-related disruption will be common due to reliance on inadequate national resources resulting from the dysfunctional operation of international energy markets. Problems of supply, with a focus on supporting critical infrastructures will see disruptive shortages and outages as commonplace.

Weather related disruption resulting from the effects of climate change will be frequent, although the major national networks will be resilient due to robust planning and mitigation strategies.

User expectations and levels of support will depend on who you are and your willingness and/or ability to pay. Customers at the premium end can access specialised services to mitigate disruption, building on journey planning and information services. Some peer-to-peer support networks exist at the top and bottom of society, but most in the middle are distrusting and act independently according to their means. For the poor, disruption is expected and planned for, people are highly resilient deploying self management strategies, but tend to focus on local, familiar travel as they can't access information to enable more ambitious options. At times of disruption, advertising can be a barrier to clear information, particularly scrolling through mandatory advertising to access information to make decisions under time pressure.

From the operator perspective, there is a high level of regulation on key routes and services which supporting national economic priorities (extending the TfL model of the present day to key networks, metropolitan areas and international gateways).

There is some cooperation across service providers to enable bespoke solutions for high-end customers and security priorities. This even extends to traffic signal coordination to speed VIPs through disruption. However, competing services for the masses lead to competitive use of information including partial information/misinformation and collusion. Passengers with good access to information will use brokering and group buying power to get good deals, but those with least ability to pay will be exploited.

Cyber threats will include identity and personal data theft. People will be highly concerned about single point vulnerability to technological failure with a lack of support services for those without resources. High levels of social division will lead to protest, crime and anti-social behaviour with crime displaced beyond the gaze of surveillance to 'no go areas'. Boundaries are key between managed and unmanaged environments. People are very conscious of their environments and where they do and do not belong, strongly influencing perceptions and confidence in travel.

Mitigation of these threats will be available from trusted providers of information and other services who will play a key role in supporting travel for those who can afford to pay. Back-up services (protected redundancy) will be needed to give confidence in travel in response to concerns over single point vulnerability. Car use e.g. taxi, rental and trusted DRT services bridge gaps in disruption. Collective services will support communities of trust, but the dominant trend is towards individually tailored solutions. Mobile technologies support contingency planning with service levels varying according to means to pay and elite services are highly interactive and dynamic. Surveillance protects and reassures where deployed, but the variability in safety and security between managed and unmanaged environments will be stark. Strikes and industrial unrest leads to more remote working in urban contexts underpinned by digital infrastructure.

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ANNEXES

Annex 1: Workshop Programme Timetable

0930 – 1000 Registration

1000 – 1020 Welcome and introduction to the day

1020 – 1030 Tour de Table

1030 – 1130 Scoping of current issues:

- Spikes in demand for information;
- Passenger experiences in different disruption contexts: feelings, demographic differences, coping strategies;
- Operational experiences: mitigating effects, resolving the cause; equipping staff; restoring normality; managing customers and their expectations; evaluation and learning

1130 – 1145 Refreshments

1145 – 1215 Identification of future key driving forces affecting the future for travel and travel information, emphasising trends in the frequency and types of disruption and the resulting mitigation and operational responses:

- Social: e.g. social inequalities and ghettoisation of different groups or demographic and migration trends
- Technological: e.g. data trends, mobile computing, transport technologies affecting both customer and operator
- Economic: e.g. pricing, sectoral trends affecting travel
- Environmental: e.g. as a source of disruption or as a limit to growth
- Political: e.g. democratization of data or ideological trends affecting policy; management of the security environment
- Legislative/Regulatory: e.g. new regulatory and legislative forms, driven at different levels (global, EU, national, regional, etc.) or the formalisation in regulation of trends from other drivers above (STEEP)

1215 – 1245 Introduction to scenario planning activity

1245 – 1330 Lunch

1330 – 1500 Scenario planning breakout groups

The response to disruption is dependent on context: both type of incident and scale will affect the level of response by operators and authorities as well as passenger reactions and expectations. Each group will be given two examples of a disruptive events (covering different scales), and will be asked to consider how they might play out under two different governmental/social frameworks. For the first event the groups will take an operator perspective and for the second event they will take a passenger/customer perspective.

1500 – 1550 Scenario review

Each group will present their narratives to the other group, followed by a discussion

1550 – 1600 Wrap up/next steps/thanks

Annex 2: WorkshopParticipants

NatachaCharvet	Veolia Transdev UK & Ireland
Kathryn Daniels	National Rail Enquiries
Gareth Evans	Newcastle University (SAVEME project)
Phil Halewood	Merseytravel
Rae Jiggins	British Transport Police
Pete Johnston	Transport for Greater Manchester (Passenger Information and Network Security)
KonstantinosPapangelis	Centre for Transport Research, University of Aberdeen
David Pinder	First Group
Teal Triggs	Royal College of Art
Nick Wilcox	Olympic Delivery Authority

Annex 3: Raw Data from SWOT Analysis

Q1 How do we handle uncertainty and disruption in public transport at the moment?

Thinking as passengers, as transport operators and/or authorities, security authorities and other service providers

Good points

- Planned events and routine occurrences coped with well.
 - By what measure?
 - Public feedback, operation/event debrief - providing resource is made available in advance.
- Accustomed travellers can anticipate issue and mitigation strategies.
- Olympic experience with Transport Coordination Centre, consistent messaging across operators agreed in 2 mins instead of 25 mins
 - Depends on where you are in the country and how deregulated the transport system is
- Interchange and hubs provide information and staff presence/ visibility
- Saturation messaging, adding information that people want, not just information.
- Social media can inform where the operator does not
- Usually the information that the operators provide is out-of-date, and generic.
 - Information via mobile technologies now available where Information displays not cost effective
- As long as individuals have network connectivity via GSM, Wi-Fi etc. - could there be reliance upon this channel more than "human instinct"?
- Olympics, proactive press messaging.
- Media had free access to TCC, including filming. 'nothing to hide'
- coordination of messaging is the key as the public need to have a consistent approach
- Proactive media messaging allows 'hiccup' to be accurately reported and not become a scare story
- Management presence during times of disruption

Bad points

- Inconsistent provision across space, doesn't join up
 - Also inconsistent across modes of transport
 - Also inconsistent messages across technologies utilising the same data source e.g. mobile apps and PIDs
- Often poor on vehicles, what do staff actually know? Can be inaudible on trains, etc.
- Inconsistent messages between different operators in the same area (e.g. London Bridge during Jubilee)
- Not communicating causes - can enable informed passengers to estimate delay/ plan changes to journeys

- Is ICT a solution looking for a problem - are we using it correctly?
- Current systems help seasoned travellers - we need to cater more effectively for first time users - modal shifters...
- passengers can know more than staff, as staff equipment restricted - old technology / lack of trust
- not always considering what information is being conveyed and at what point in the journey
- Timely accurate and personalised information is required
- There are multiple potential data sources for a passenger but how can they know that the source they are using is actually the best one for their personal needs at that time?
 - people don't know about what options are available to get info other than staff / telephone
- Social media can misinform and it is resource intensive for operators to manage the situation
- Not everyone has access to technologies that can provide disruption information
- great variability in operator engagement with social media
- after 5 minutes the message is dead and too late
- When rail management come out to stations to 'support station teams' (well meant, good message), they actually don't know what to do!
- A lot of disruption information is about the issue but not the way around it
- Canary Wharf example: station is 'closed' because it is over-crowded. However, problem caused by signalling at Stratford (which takes 40 minutes to resolve). Passengers are not told this, nor how long the problem will take. Honesty in information is important to enable people to cope.
- Many transport operators do not want to share disruption information as they fear it shows their poor performance
- often the front line staff do not have the information required for accurate advice and messaging - they will also not know what other modal operators are doing
- technology is not used for messaging information for staff enough
- transport is becoming a 3 tier system, London, large cities, rural
 - or maybe 4 tier

Other comments

- Olympic transport planning was focused on mass movements, not the personal security of individuals
 - would not totally agree with this, certainly in my experience Olympic planning included contingencies to reduce disruption through the implementation of security measures
 - Travel Ambassadors all had iPads during the games [to help individuals].
- If internal, operator can manage, if 3rd party emergency then control of problem can be lost - scaled up
- Human presence is reassuring but expensive - often only deployed on planned or 'emergency' scenarios.

- in Olympics, G4S fiasco was actually really good for distracting the media who were hungry for 'negative stories' about chaos
- Are there external personal experiences (domestic issue, bad day at work etc.) which can have an unintended impact on how safe/contented people feel whilst travelling?
 - bad day at work
- Journeys can be complex and the impact of disruption can be complex too how to support pax [passengers]?

Q2 How do we recover the situation?

Explore how differences in expectations/objectives might influence decision-making and how information is supplied and received

User

- Not always able to mitigate due to lack of information or scale of problem
- Attempt to quell anxiety by actively seeking information. Smartphone is reassuring for me, hate not having a signal.
- Users are probably the weakest stakeholder at times of disruption, at the mercy of others or technology (as long as they're 'techy' people)
- The individual user and needs - taking into account time of day (e.g. lone women and late night travel)
- During bad weather (2010?) I was evacuated from Coventry Station which had a power outage. I was evacuated by being told to get on a train. Great. But it went in the wrong direction! Had to change in Birmingham, get next train south, which was one hour later than my original train, which apparently ran as normal. As the resolution was reasonably swift I was more or less ok with this, but I travel quite a lot. What about someone less experienced with rail travel?
 - During the "Toon Floods" over the summer, the transport network started to fall apart but all operators actually pulled together for once!
- Passenger requires information about disruption to their journey, not what is happening to the network
- Huge differences by type of user

Operator

- Depend on nature of the disruption and whether it is under the control of the operator or not.
- Help each other - ticket acceptance (should be agnostic of type of tickets purchased)
- Disruption due to road/utility work -> close liaison with LA and highway authority to plan them and agree alternative route/stop
- Congestion: use real-time information to review running times, bring additional vehicle
- GPS not used by rail operators to tell users where trains are on the line!
- Agreement with bus operator to implement bus replacement services when disruption on train/tram will not recover quickly

- Contingency plans can often cause more disruption in the short term, but aim to aid service recovery in the long term.

Information providers

- Coordinate operator messaging
 - i.e. try & make sense of differing stories
- Proactively message customers to try & prevent escalation of problem - i.e. stop people turning up at Kings Cross if there're no trains
- Perspective on the effects of disruption can differ; a severe delay on a tube system could manifest itself in a few minutes at one end of the line and tens of minutes at the other. Different traveller groups will be affected and respond differently
- Provide accurate alternative travel options
- Well known and practised and well known contingencies help a speedy recovery

Security authorities

- Legislative/regulatory processes can take over, preventing you from controlling the situation e.g. scaled-up to other authorities or nature of incident requires a specific response e.g. suspicious incident at level crossing, crime/terrorism etc., require intervention by another authority who 'takes over'

Transport Authority

- Collaboration - strong relationships generate this.
- Resilience planning, regular events.
- Understanding and anticipating the needs of customers to enable mitigation strategies to be developed/maintained.
- Appropriate contractual arrangements/obligations.
- Passengers do not care what difficulties we have to get the information - they just want to get it
- We want to provide a consistent message regardless of who the local operator actually is but can't necessarily control it
- Issues and customers do not recognise organisational boundaries.

Q3 What makes a drama into a crisis?

The importance of time, space, and demographic: how do any of these factors influence whether small incidents escalate in severity or scale?

Time of day/year

- Weather - delays in winter more serious than summer
 - How exactly are they more 'serious' - longer? More difficult to resolve? Or have more serious potential consequences for passengers?
- People feel more vulnerable at night
- Hot weather e.g. stuck on tube

- Winter stuck in a rural unsheltered bus stop
- Time of day, day of week changes the type of passenger from experienced traveller to inexperienced.
- Depends if it causing people to be late for work, meetings etc.
 - Evening delays more disruptive for people who need to pick-up their kids from school, nursery...
- Leaf fall season causes significant problems to train operators, but we could be better at informing passengers why this has such an impact.

Type of area (e.g. rural/urban);

- Ability for emergency services to access incident influenced by geography
- Scale of impact often relates to population density/distribution
- The lack of access to alternative modes or services can incubate the nature of the event and the consequences.
 - No means of moving passengers and/or addressing the issue - the nearest train on a single track route may be 30 miles away, i.e. Cumbria, Scotland...
- For rural areas response times of recovery teams are likely to be longer, therefore it takes longer to restore situations.

Demographic (e.g. age/gender)

- Disabled people may have more difficulties coping with disruption, as they have particular accessibility needs, or can't access information sources
- Peak period passengers will react very differently to daytime ones (ENCTS users, tourists, school children) and evening ones.
- When disruption changes a daytime journey into a night time journey this can change perceptions of risk, particularly for elderly/female
- Familiarity influences impact, regular users expect delays, also bad isolated experiences influence perceptions

Other

- Twitter!
- Lack of information where people are having the conversation
- A series of unpredictable, unrelated events can rapidly escalate.
- Global events will raise awareness of 'security' issues that then lead to escalation of a simple 'event'
- Cross modal - impacts hinder each other i.e. a fire at a tube station where the fire service utilise the bus terminus area
- Level of familiarity with a journey, and each link in a journey chain - what happens to you during a disruption on an everyday, regular journey is totally different to when you are making an unfamiliar journey for the first time
- Lack of communication between stakeholders, lack of resilience training
- Lemming effect of suicides
- Attendance at scene of emergency service workers who do not understand the implications actions have on the network i.e. action in Milton Keynes impacts on London and Glasgow etc.

- Availability of information - a totally useable alternative may be near to hand but if you cannot access the information it is useless
- Depends on whether or not it is a 'connecting' service
- Nature of incident - e.g. crimes have specific protocols that must be followed
- Operator decisions - suicide in Surbiton area - SWT kept sending trains into the area, resulting in lots of stuck passengers, mass disruption, overheating / no info / passengers forcing doors etc.

Scale of incident

- Incident on high frequency line - impact is huge
- Small incidents in certain locations could quickly have impacts which ripple outwards and cause a larger scale disruption across various networks

Q4 What will affect how we handle uncertainty and disruption in the next 3-5 years?

What could we do differently, where are the opportunities for technology and/or information to improve recovery from disruption and the journey experience? What are the major current and emerging barriers to improvement?

Opportunities

- Crowd-sourcing disruption information
- Increased understanding of technologies/social medias and how they operate
- Olympic legacy used to enhance provision/services
- A different demographic - socio economic (age, mobility, affluence, familiarity with ICT, etc.
 - Better quality infrastructure? Rolling stock (road/rail) with improved safety and ICT/comms systems.
- Greater awareness of the role 'design' can play in informing solutions
- Location based disruption info
- Utilise on train GPS to enhance rail industry real time information system
- biometrics could get quicker
- Better coordinate information across operators/providers - technology to develop a central hub, including traffic info, emergency services, etc.
- live info going to all stations
- not only disruption information but also what causes the disruption, how long it is expected to last (based on historical data?) and provision of alternatives
 - In certain, potentially critical or life-threatening situations, how much information should the passenger be given in case it could create further panic/annoyance/frustration?
- integrated ticketing
 - live info linked to ticket purchase
- sharing of information between operators
- Higher levels (!) of CCTV coverage or blue tooth personal tracking (?)...

- May be perceived as a threat too.
- A move towards seamless mobility would help with disruption.
- Centralisation of RTI on rail (via NRE) currently 66 different systems for station displays that don't talk to each other!
- CCTV analytics
- OPEN data
 - OPEN LINKED data
- Improving telemetrics for knowing exactly how many passengers there are and where they get on and off vehicles - useful for emergency services?
- Passenger loading info - this train is full!
- GPS and data information is already at a level where individual tracking and data could be introduced now

Threats

- Not exploiting the Olympic legacy - including impacts on staff morale
- Economic environment
- Senior management not understanding/underestimating new technology (e.g. hand held mobile devices), they are 'late adopters' and not good at imagining how technology can develop
 - But could this attitude change as the more-techno savvy generation move into employment?
- lack of investment in old infrastructures
- Over-reliance on technology, even if systems are robust, well-developed, reliable etc. what happens when they *don't* work as expected?
- user and/or stakeholder complacency
- commercial considerations preventing 'sharing' of smartcard chips (e.g. transport ticket, workplace access, banking on one chip)
- Older, life expired infrastructure and kit - if investment dries-up.
- business drivers overriding user needs
- Fewer human resources available to manage the situation.
- companies are often not keen to share data platforms and carriers such as electronic cards and allow other providers to have an identity on it for their use
- Big brother considerations, people don't want all their data captured
- Malicious and or criminal use of technology e.g. social media
- Less and inexperienced staff as the grey generation have retired and their knowledge gone with them.
- Lack of awareness of the role 'design' can play in informing solutions

Annex 4: Raw Data from STEEP(L) Analysis

What will be the key future driving forces influencing the occurrence and experience of travel disruption beyond 5 years?

Considering beyond 5 years - emphasising trends in frequency of disruption and types of disruption (e.g. from extreme weather, social unrest, crime, technical failure) and our resilience to it.

Social

- Greater dependence upon PT - less and lower wage earners (inc. the young and old) who cannot afford or are not allowed to drive.
 - Or afford public transport?
- As the PT networks get squeezed further, are we potentially looking at a greater number of people who are impacted by a single disruption event?
- Greater acceptance of congestion, disruptions are things that 'just happen' and are tolerated as part of daily travel
 - tolerance depends on location though
- rise of alternative living communities - move from city to rural or vice versa
- requirement for multi languages
- More riots?
- what will the public attitude to disruption be - more/less acceptance
- social desire for seamless travel

Technological

- bandwidth - as more is required to accommodate all the information highways transport may be a poor cousin
 - For transmission of data. transport is poor relation, but it needs bandwidth for operations
- companies such as Starbucks can pay more for Wi-Fi bandwidth than transport companies
- power supply
 - Everything is consuming more and more. Battery technology needs to improve.
 - Transport also needs a power supply. Electrification of rail, AND of EV strategy - where does the electricity come from and what are the implications for the national grid?
- More intense use of existing networks - can maintenance, supply keep up with demand, provision of new capacity - cf Switzerland...
- New transport techs come with infrastructure issues i.e. H2 buses need new bespoke garages and fuelling points. The old infrastructure cannot often be adapted to change.
- In-memory processing of data - process mass data from multiple sources much more rapidly
- ubiquitous technology

- Star Trek scenario
- Standardisation between systems is needed to ensure continuity

Economic

- Maintenance of infrastructure is costly and failure to upgrade mean vulnerability to disruption increases
- Funding availability /appetite for big infrastructure projects
 - Mainly big projects funded - cost of consultation
- Will PT services look the same in future? Services which are not economically viable may change/disappear e.g. DRT replaces scheduled PT.
- EU, global or local economies - what will influence UK decision making or will it be done for us - and others?
- Rural PT services are vulnerable - how cope with disruption if there are no alternatives?
- Reduction in number of operators may make things easier for co-ordinated information

Environmental

- extreme weather events are increasing frequency and climate change theory suggests this will continue
- People's attitudes to green agenda, will transport operators react? carbon impacts of journey
- energy availability will change moves to renewables/alternatives to fossil fuels
 - huge infrastructure change needed
- disruption caused by energy shortages/supply problems
- Infrastructures vulnerable to weather, esp. ageing
- Solar flare might knock out all GPS and radio comms.

Political

- Transport interventions are long-term 'things' yet politics works on the quick win, short-term delivery whilst in power
- increased instability of political structures
- Local vs. Regional vs. National vs. International political agendas do not necessarily work towards common objectives
- Political 'silos' don't talk between departments
- alignment/or non-alignment of political beliefs - everybody (even environmentalists) agree that the SE needs a better system, but can't agree whether it is NS or air, and can't agree where it goes. This is an important driver.
 - What about the other parts of the UK? Spending on transport per head in London/SE is significantly higher than elsewhere
- hacking culture and who has ownership of data
- the current uncertainty over rail franchising will have political implications - process will need to be completely redesigned

- political change can have wide reaching consequences i.e. the effects of taking articulated buses off London streets on the European bus purchasing industry
- Party politics or is this dead - with consensus between many independents' leading the way?
- Desire for more regulation of buses
- Possible nationalisation / one franchise - of all London Rail

Legislative/ Regulatory

- Where will we be - will economic growth desire outweigh carbon agenda; which will win...?
 - This will dictate the direction of regulation.
- Legislation will/may change due to global and/or domestic incidents - unknown at time- but impact will occur
- Quality Contracts for bus operations
- customer expectations only increase - more stringent performance monitoring of services in legislation during disruption
- Trajectory of Regulatory regime for buses will influence development of bus networks (e.g. in London decisions about new Bus for London will remain in force until about 2025 before change can occur)

Annex 5: The Scenario Narratives from Work Package 1

World Markets

Individuals ignore national and regional barriers as they strive for material wealth and mobility. International and long distance domestic travel increases for those who can afford it. There is growth in demand for complex journey planning services. People value high quality services such as multi-lingual automatic translation for way-finding in unfamiliar environments. Innovation is initially spurred by the sharing of international best practice, but commercial imperatives lead to a small number of multi-national global corporations dominating provision of these services. The car is the mode of choice for local journeys, and to access long distance travel by PT, for those who can afford it. This leads to increasing emphasis on infrastructure, facilities and services, including traveller information, which support car access to PT interchanges. Quality information is only provided where there is clear commercial benefit, resulting in fragmented information provision.

Those wishing to travel beyond the locale depend on service providers to join-up this fragmented picture at a cost. For those who cannot afford such services there will be decreasing confidence in travel and narrower travel horizons as people place their faith in familiar environments and trusted services. As PT services reduce in scale and quality there is an increasing role for Demand Responsive Travel services to bridge the gap. These services are commercially driven, with trusted service providers facilitating access to key travel generators such as business parks, industrial estates, airports, or shopping malls. The desire to maintain independent travel drives growth in alternative models of car ownership and use such as car clubs, car sharing and on-street car hire. However, car clubs and car sharing are less 'open' than in the past, with membership oriented around rigorous profiling and/or pragmatic relationships between trusted peers with shared interests.

Target hardening is an issue of increasing concern. Cars and mobile phones are increasingly secure with access and use controlled by PIN systems and biometric data. Remote device shut down will deter theft, but this shifts the vulnerability from the technology to the owner, increasing violence and intimidation to access their biometric and PIN data. The bespoke information and journey planning services which emerge in this scenario require the collection of sensitive personal data. Secure data storage is also major concern and individuals are reluctant to share information reducing the role of open data. Social media is limited to closed communities of interest managed by trusted service providers, who tightly control access. The high monetary value of traveller information means that commercial imperatives prevail over open access to data, reflected in the role played by multi-national corporations in data ownership.

Global Responsibility

Society is highly cohesive and conformist, with a bias towards achieving community-oriented consensus. The population is highly educated, feels secure and trusting of one another. Citizens and businesses are highly taxed, as the social value of public goods, including PT, is recognised and well-supported. The cost of providing services and information is shared between parties to give economies of scale.

Disruptive radicals are rare, but more dangerous due to lower levels of social 'alertness'. Extreme criminality or terrorist acts are deeply shocking to society, but the response is not to impose draconian security controls. The openness of society and its reliance on open data raises the threat from cyber attacks, and physical attacks on infrastructure, as there are few barriers to information for the determinedly disruptive. However, policing functions are highly computerised and ubiquitous, with technologies such as CCTV and facial recognition developing to a level at which the cost has reduced. Antisocial behaviour and crime is reported immediately using social media, enabling fast and accurate response and reporting, enabling accurate public perceptions about safety and security in the travel environment.

Public authorities and commercial data holders are committed to making their data available, and work collaboratively, utilising public feedback and government-sponsored standardisation. There is a high level of cooperation between universities and industry, and across sectors, in sharing intellectual property. The use of open data and the cooperative nature of society supports the development of shared travel services. The interests of minorities or groups who tend to feel more vulnerable at present are well-provided for in service and information provision, and they feel safe and confident in using PT. There is very little emphasis on the use of cars for local journeys because of community preferences for high air quality standards and low noise, healthy environments, with active travel and/or PT used for work and leisure travel. The well-integrated and multi-modal transport networks are very data heavy, to support operations and traveller information. Social openness leads to innovations in Augmented Reality Technology to find fellow passengers with common interests, to find empty seats on crowded trains, or find carriages that aren't deserted so people can gain comfort from not being alone. Direct information about the immediate travel environment is available through community-led social media, e.g. people at one end of a train use mobile devices to tell others where there are empty seats.

National Enterprise

Society is motivated by national and individual self-reliance, with the operation of PT and related information services characterised by fragmentation. Infrastructure and service priorities are oriented around 'homeland' security. Major investment priorities are key national infrastructure such as the motorway and national rail networks and major interchanges, designed to link the major metropolitan centres as engines of economic growth. There is an emphasis on protecting borders and international gateways such as ports and airports. These priorities result in clear disparity in the level of investment and services between priority areas and peripheral places.

The technologies which underpin traveller information services are developed at the national level, an insular approach retarding innovation by ignoring international best practice. The absence of global players in the market means that competition does not drive forward innovation and economies of scale. In the absence of economies of scale, an alternative economic model emerges for information services. PT and related information services that are not economically viable decline and even disappear. Those that remain only provide information beyond minimal standards when there is clear commercial benefit e.g. to support ticketing or advertising. The fragmentation of service provision creates a market for systems and services that join-up and co-ordinate to support travellers. A high degree of differentiation in services is available, regulated by pricing and privilege passes to first class PT facilities are popular. Brokering systems and services play a key role in supporting travel and commercial DRT services fill gaps caused by the decline in PT provision. However, the private car remains the travel option of choice for those who can afford it. Infrastructure, services and information to support access to PT by car are investment priorities.

A stark digital divide contributes to wider social polarity. Access to information and services is unequal and the highly prioritised uneven investment in infrastructure and services leaves those at the geographical margins most vulnerable. De-regulated service provision affords very limited protection for the vulnerable. Information provides a critical role in supporting personal security, but quality information is costly because RTI has become valuable as services deploy dynamic fare systems to regulate access. The lack of community support makes information systems particularly important. Mobile technologies act as 'travel buddies' and systems and services become increasingly sophisticated and bespoke. Lack of trust in notions of community and data-sharing cause a decline in social media and open data. Trust is placed in national political and cultural institutions, reflected in the small number of official providers of traveller information. Citizens carry a National Identity SmartCard incorporating biometric and location tracking data as well as banking and ticketing functions. The high degree of surveillance is the main source of security in travel and in the urban public realm. Though predicated on the importance of maintaining homeland security, it also provides reassurance for local travel and day-to-day living.

Local Stewardship

Most powers are devolved to local and regional authorities, leading to fragmentation of approaches across national space. Although there is a high level of environmental awareness, it is locally or regionally oriented. Most journeys are highly localised and active travel prevails for health and environmental reasons. This has changed the nature of PT provision, which adapts around a fitter, though older, general population, who have different journey patterns based on using a mix of owned and shared bikes. There is a growth in local bike hire schemes integrated with PT access points. Travel environments are more age-friendly, with better pedestrian routing and lighting, supporting confidence in independent travel. Information provision makes realistic allowances for the walking and cycling segments of journeys. The resultant network is simpler and easier to understand, making the provision of RTI easier. However, the model of a mix of commercial and subsidised services is much the same as in the present, though substantially based on contracts between the operator and the funder. The services are differentiated to cater for diversity of need, and information provision is similarly fragmented. The significant growth in the numbers of extremely aged increases the number of mobility-impaired citizens who cannot cycle or walk, and are disadvantaged by the shrinking of local bus networks, making them reliant on bespoke services to access healthcare. Similarly, distinct communities such as students are more dependent on PT for specific activities, such as accessing leisure and returning safely from nights out.

Technology is increasingly used to support home-working, reducing the need for face-to-face meetings, and for commuting. There is a reduction in longer, non-routine trips, but those that are undertaken are supported with good information provision that enables people to cross local and regional boundaries between services and standards with confidence. Local broadcast media increasingly provide real-time information about travel conditions in the locality, and DAB pushes localised travel information to geo-located mobile devices, enabling travellers to remain up to date and able to adapt journeys, regardless of mode. PT provision provides plenty of space for bicycles on vehicles and better bike storage at interchanges. The local and community-oriented lifestyles reduce threats to personal security, though there is an increase in cycle theft.