

**Plenary Session VI - Specific transport security
aspects and the role of the OSCE
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**Discussion paper
The use of cost benefit analysis and economic
assessment in rail transport security**

Executive Summary

The use of economic assessment as a policy tool to assist decision makers within the transport sector is well established. To evaluate policies in transport safety, methods such as cost benefit analysis and value for money are regularly used. For security measures it is more difficult to assess the economic benefits and for counter terrorism measures, which is the subject of this paper, it is even harder due to the absence of data on incidents.

Nevertheless, some form of economic appraisal can be applied to security measures but there are significant limitations. The lack of data on the frequency of incidents means that a cost benefit analysis or value for money assessment cannot be completed without a degree of uncertainty. Understanding the financial cost of a proposed measure will assist policy makers to make comparisons and decisions. This economic evaluation can be informed by the actual costs of the preventative security measures themselves and the financial and social cost of an incident if it was to happen.

Unlike other areas of transport appraisal where economic models are regularly used there is currently no recognised methodology for decision makers when it comes to counter terrorism security - this is the challenge. Ultimately the purpose of an economic appraisal should be to assist policy and political decision makers to make informed decisions.

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Introduction

- 1) The use of economic assessment as a policy tool to assist decision makers within the transport sector is well established. There are well thought through arguments about how to apply economic assessment to the field of transport safety and more recently environmental concerns in this sector, such as the carbon footprint from travel. This paper considers whether similar economic assessment could be applied to security policy in the rail transport sector.
- 2) In order for policy makers to make decisions it is necessary to compare different policy interventions against one another and against a 'do nothing' option. For the majority of new policy interventions a financial cost will be imposed and policy announcements are often accompanied by a statement that extra money is being made available to fund the measures. Therefore there is a strong argument for analysing policy options using economic assessment.
- 3) Increasingly policy interventions are accompanied by an impact assessment, which identifies both likely positive and negative impacts. Often this comparison is on the basis of financial costs. For example financial values have been determined for peoples' lives, injuries, journey time delays and interruption to business/economy. The most common method of economic comparison used by policy makers is cost benefit analysis or value for money comparisons.
- 4) As a general rule a policy intervention should show a positive cost benefit. However, there might be political or public pressure to introduce measures that outweigh financial considerations. Also it has to be recognised that not everything can be measured in pure economic terms. The level of certainty around some of the costs associated with particular factors might be questionable and need to have a sensitivity test to show how robust they are. Also sensitivity tests could be applied to other assumptions being made to improve their robustness.
- 5) Nevertheless, in the current climate when harsh financial decisions need to be taken by administrations and governments, having some form of mechanism to compare different policy areas is necessary. It therefore makes sense to start with the premise that economic assessment should be applicable to policy interventions including that of rail transport security.
- 6) This paper initially concentrates on economic assessment of a rail transport safety policy. It shows how a similar approach could be taken to rail security and also highlights its limitations. This paper also recognises that examining policy interventions that are directly

linked to protecting passengers and rail assets are not the only security measures in place. Counterterrorism measures generally are likely to have a positive impact in improving rail transport security.

- 7) These measures range from de-radicalisation of people, gathering intelligence on suspects, to police led operations to intercept terrorist attacks. It is also possible to reduce the impact of an attack by being adequately prepared to deal with the aftermath. In an open mass transit environment like rail, where it is arguably impossible to be one hundred percent confident of preventing an attack, this is an important consideration.

Economic assessment of transport safety measures

- 8) For safety measures across all transport modes there are reasonably well established economic methodologies such as cost benefit analysis and value for money methods to evaluate policies. An example would be to evaluate measures to reduce fatalities and serious injuries to passengers involved in a train collision or derailment.
- 9) In this example there are potentially two areas of policy intervention, introducing safety measures to prevent the accidents occurring in the first instance or improving the crash performance of the train structure. Each one would have a financial cost associated with its implementation. This would involve capital investment and ongoing maintenance costs. A view on the effectiveness of each measure would also need to be determined by experts based upon past accident data. The financial benefit could be derived from preventing or reducing severity of the passenger injuries, damage to trains, delays to service, etc.
- 10) By understanding both sides of the cost and benefit equation, it is possible to conduct an economic comparison. However, to have a robust analysis there needs to be sufficient information on what happens in an accident and their frequency. This will provide the evidence upon which to assess the benefits that could be realised and enable a cost benefit analysis (CBA) or value for money (VfM) assessment of the proposed measures.
- 11) The assumption would normally be that the frequency of accidents would continue, unless the policy intervention is undertaken. This would not be an unreasonable expectation but care should be taken to discount any other external factors that could influence future accidents - past events are not always accurate indications of future events.
- 12) In conclusion a CBA or VfM analysis would be made up of the financial cost of introducing the measures compared with the benefit from preventing or reducing the effects of future accidents.

This would be calculated on the basis of financial savings in reduced injuries, infrastructure damage, delays, etc.

Background information needed to conduct economic assessment of security measures

- 13) The key aspect in the above safety scenario is the availability of data from past accidents which supports robust evaluation of the expected benefits and thus confidence in the analysis. Unlike terrorism, statistical trends relating to safety would normally change gradually over time rather than dramatically and this provides the necessary quantity of data. (The exception perhaps is a major safety incident that brings a disproportionate amount of publicity and pressure for government to act.)
- 14) Terrorism is dynamic and so unlike safety policy interventions, solutions have to take account or at least recognise that a terrorist could change their method of attack to circumvent any measures in order to still hit their target. Also there is a likelihood that the underlying probability of attack will change independently of an intervention. Terrorism is also dynamic in the sense that a previously inactive terrorist group or cell could commence attacks with little or no warning. They could be quite minor in nature or result in many hundreds of fatalities. An example of this is 11 September 2001 terrorist attacks on the World Trade Centre and Pentagon in the USA.
- 15) In Europe there have already been two notable terrorist attacks on the rail network. Madrid on 11 March 2004 where there were 191 fatalities and 1800 injured, and in London on 7 July 2005 where there were 56 fatalities and 700 injured. Whilst the method of attack was different in each case, in both instances it showed the desire by International terrorists to cause mass casualties and adverse economic impact by disrupting rail transport services.
- 16) Whilst there have been other attempted attacks on the transport sector in Europe by International terrorists or sympathisers they have been relatively infrequent. Where there is some similarity between terrorism incidents and major accidents is the public response for action, especially if there is significant loss of life on public passenger transport. This is likely to be down to the level of risk society will tolerate.
- 17) Nevertheless a similar economic approach of identifying financial costs could be applied to evaluating counter terrorist policies. Counter terrorism and safety measures can be viewed as having positive and negative aspects. A clear benefit would be in preventing an attack happening, thus saving loss of life, damage to property etc. A negative aspect would be time delays to a journey. But unlike a safety measure there is not usually a proven history of similar events upon which to evaluate the proposed measures and

the threat landscape is changing. This means that proving that the proposed measures have prevented an attack is very difficult.

Terrorism threat - national/global level

- 18) An act of terrorism may be from national or international groups. The target of an attack, and the methodology used, is dependent upon the groups involved, their capability and aims. Currently the threat from International terrorism is predominantly from Islamic extremists. The threat is global, but the risk of attack is greater for some countries than others. The reasons for this vary, but could include cultural factors, historical events and/or current foreign policy.
- 19) At a country level the threat from International terrorism could vary between transport and non-transport sectors. Within the transport sector itself the threat might vary across the different transport modes. Rail stations are usually located across the whole of a country and differ in size and the type of services they provide. Rail lines might be for passenger, freight or both, whilst rail operation could be high speed, commuter or local service or a combination of each.
- 20) The actual method of terrorist attack can take many forms. The most common grouping of attack methodology is chemical, biological, radiological, nuclear and explosive (including improvised), (CBRNE). Within each of these the actual method of deployment or chemical agent used could be different. Consequently the security measures needed have to be relevant to the current threat or dynamic to a potentially changing situation.
- 21) An added dimension for some countries is that there is also a threat from national terrorism or extremism. This would be country specific but could be limited to a particular geographical region or locality. The type of threat and the target are not necessarily the same as the international threat; therefore the measures could be different. These would need to be factored into any economic assessment.

Financial cost of implementing security measures

- 22) The financial costs associated with the introduction of a policy could be defined as either capital or operational. For example capital cost for the private sector could include items such as screening equipment, hostile vehicle restraints and other security measures incorporated into the building. Business rules on how capital costs are depreciated would need to be observed. When estimating the financial cost of new security measures there is tendency to underestimate, therefore factoring in an optimism bias is normal. The figure of bias will depend upon the nature of the measure. The more innovative the measure the higher the bias would tend to be.

Operating expenditure would be the ongoing maintenance of equipment and staff cost to operate the equipment. It would also include staff carrying out security checks as part of their duties, security staff deployed on the railways and their training. A key issue to consider is over what period of time these costs should be considered.

- 23) Any financial costs should also be identified for the public sector. If the capital expenditure is being met from the public purse then it should include the cost of capital – the benefit that would be gained if the money had been invested. There could also be a public sector cost from officials administering the private sector carrying out security. This could include regular site inspections and where necessary taking forward enforcement activities for non compliance of the rules.
- 24) Depending on the security measures being implemented there might also be a need to include the financial costs imposed upon passengers and other businesses connected with the rail network. These could include delays to passengers' journeys caused by the measures and from revised business operating practices, such as restrictions on delivery times for goods. For major changes to a station building, e.g. installing hostile vehicle mitigation, there might be significant disruption to passengers and business during the actual construction phase. When costs are being accrued over several years, net present values (the value of money as of today) should be used to make suitable comparisons between options.

Financial benefits of security measures

- 25) Regarding these benefits, this will be derived from preventing an attack. These benefits should be considered at both the micro and macro level. By establishing different terrorist attack scenarios it is possible to determine the likely impact they would have if they were successful. At the micro level impacts would include number of casualties and their severity, infrastructure damage, clean up costs (if a chemical attack) and delay to passengers and train operations. An economic value can be attributed to each of these.
- 26) At the macro level, influencing travel behaviour (moving to private car from public transport), adverse impact on international tourism and financial market confidence should be considered. It should be possible to make an economic estimate of these factors. For example a 10% reduction in international tourism in the UK would equate to roughly 110 million Euros in a year.
- 27) In order to consider a range of scenarios it is necessary to have undertaken operational analysis on how detonating different sizes of explosive device would affect likely number of passenger casualties and the extent of damage to infrastructure. Quite clearly a person borne explosive device and a vehicle borne explosive

device have different capabilities, both in terms of their impact on people and buildings. Nevertheless, the potential for mass casualties, disruption to passenger travel and the financial cost is potentially huge. Being able to detonate a vehicle inside a crowded station concourse as opposed to outside it could also have a significant difference.

- 28) Railway stations are inherently different, many are very old and they are normally located within densely populated urban environments, which place additional constraints on what security measures can be deployed. Also the precise location where an explosive device is detonated within a rail carriage or train station could make a significant difference. Nevertheless, with all these variables it is still possible, using operational analysis, to determine some representative scenarios using certain basic assumptions.
- 29) Railway stations and trains by their nature tend to attract large numbers of people both during the day and during the evening. Therefore, potential loss of revenue to shops, pubs and similar establishments would occur if there was an attack on a train station indicating that there is a potential saving here too.
- 30) Having effective regular security patrols, passenger screening and Close Circuit Television (CCTV) as counter terrorism measures also provide a benefit in reducing general crime on the transport network. There are also arguably other benefits that are not easily quantifiable. These include greater public reassurance from, for example, seeing security patrols and other overt security measures in place.

Comparing the financial costs and benefits of security

- 31) Having identified the financial costs of a security measure and the financial benefits that could be derived if an attack was prevented, it is necessary to compare them. The challenge is having a robust method of comparison. To understand whether the benefits would be materialised means assessing how likely an attack is to happen.
- 32) In the safety scenario outlined above the need to have good data showing a history of events was emphasised when undertaking economic analysis. Unfortunately unless the attack scenario is in a theatre of war - where the frequency of incidents is likely to be high - data from incidents are likely to be very low in number. Also policy decisions are actually needed before the attacks begin or very shortly afterwards if there has been no advance warning. The absence of historical data from past events presents a major problem. With a very small data capture there will be inherent uncertainty when evaluating any specific policy intervention.
- 33) Intelligence about terrorism groups should be more plentiful and assist in identifying which member states are likely to be targeted,

how many terrorist groups there are and likely targets. However, this information by its very nature is sensitive and usually cannot be published, so it would be difficult to use in any financial evaluation that needed to be publically transparent. In the UK however the International terrorist threat to the country is published so this provides some degree of context for any assumptions. There are five threat levels ranging from 'low' to 'critical' with the highest meaning "an attack is imminent". There would be a degree of subjectivity but using this information could assist to construct an argument for security measures, but as demonstrated in past attacks, absence of intelligence in a particular area does not necessarily mean that there is no threat.

34) Terrorist attacks are by their nature high impact low probability events. This means that it is not possible to predict with statistical confidence the likelihood of an attack taking place. The exception is when there is historical data on previous attacks. An analysis tends therefore to lend itself to a more subjective evaluation. An analysis of other forms of event, such as floods/national disasters suffers the same problem. Whilst this is true perhaps the key difference is that unlike the 100 year wave, terrorists are easily able to adapt their attack methodology so that the security measures in place may not be effective due to the variable nature of attacks.

35) The risk of an attack is made up of the threat, vulnerability and impact. When discussing risk, a judgement needs to be made on what is an acceptable level – ranging from risk management to risk avoidance. As low as reasonably practicable (ALARP) is a phrase commonly used in the safety environment to describe an acceptable risk level.

36) As some security measures could take a long time to implement consideration needs to be given to how long the current terrorist threat is likely to be issue. It has been stated that the current international terrorist threat is likely to be here for a generation. Also transport is a known target. On that basis it could be argued that there could be one or two attacks on the rail sector over a 30 year period. On the other hand if the security measures take a long time to install threat tactics could change over the time required to fit them.

37) There have previously been two successful attacks on the rail sector, so the question that should be asked is - could this be repeated? The intelligence services are perhaps best placed to answer this question. With the above information it should be possible to identify potential scenarios and make some broad assumptions on the frequency of attack. This information would at least provide an indicative cost benefit analysis using a given scenario.

- 38) The cost benefit analysis would be influenced by when an attack was presumed to have been prevented, so a sensitivity analysis with different years would need to be undertaken. The outcome would be a range of cost benefit ratios. If agreement could be reached on one it could then be compared with other competing measures either within the field of security or with other areas such as safety.
- 39) Alternatively if the uncertainty around predicting the frequency of an incident is too great, but the threat remains real and credible, having an agreed methodology for costing security measures and an understanding of the potential savings of an attack if it were to happen could allow a judgment to be made. For example if security measures are estimated to cost 10million Euros and a scenario benefit is estimated to be 200million Euros, a view could be taken on whether to make an investment decision. It might be that there is more than one security measure that is being proposed and so a comparison could be made between them.

Application and effectiveness of security measures

- 40) In examining a security measure, factors such as how effective it is likely to be in preventing a successful attack need to be considered. The assumption that has been taken so far in this paper is that the security measures would be successful in preventing an attack. A view needs to be taken on whether this is appropriate for any new security measure. For example this might be a reasonable assumption if all passengers are screened for explosives before entering the rail network, as in an airport style arrangement. However, if only a small percentage of railway passengers are screened this might not be a reasonable assumption. This needs to be factored into any economic assessment.
- 41) On the other hand consideration should be given to whether the measures need to be applied equally across the whole of the rail sector. Does the terrorist threat mean that only certain areas of the rail sector would be targeted and would this vary from one member state to another? This is especially relevant in the open mass transit environment where for example a hundred percent passenger or luggage screening might not be necessary even it were to be technically feasible and cause minimal delay to passengers.
- 42) The ability to get onto a railway line or train at any point and end up at a specific location which could be seen as an attractive target does present a major problem. Other aspects that are less clear are how much a relatively small degree of protection could deter a terrorist attack. This would very much depend upon what type of attack and aim of the terrorist organisation.

43) Whilst some of these points apply equally to other transport sectors the open nature of rail network, unlike say the aviation sector which is largely a closed system, is integrated into the built environment and therefore presents unique problems for designing in effective security.

Alternative methods of attack and displacement to another target

44) If the security measures are effective, this could force terrorist to concentrate upon either another method of attack, area or sector. An example would be terrorists changing from an improvised explosive device to using a chemical device, which the measure would not have necessarily been designed to detect. There are, after all, very few security measures that are effective against all types of attack. On the other hand not all terrorist groups have the capability to adapt easily to another method of attack.

45) Similarly if the measures are successful, displacement to another sector could take place, especially as the current international threat is to crowded places and economic targets. Also it has to be recognised, that if the attack method or sector changes it could potentially be more disruptive and damaging. Arguably these factors should be factored into an impact assessment and cost benefit analysis, but there needs to a reasonable approach taken to the analysis.

46) Another aspect to consider is how effective a security measure is as a deterrent to the terrorist. Some overt measures such as screening people getting onto a train or vehicle restraint measures around a station could prevent a suicide bomber from undertaking an attack. Similarly the belief that there are covert security measures that would detect an attack might be a deterrent. However, this is a very difficult area to subjectively assess let alone quantify for any particular terrorist group.

Wider aspects of counter terrorism security

47) Security of the rail sector cannot be considered completely in isolation. There are other areas of government that actively engage in reducing the risk of terrorist attack. At one end of the spectrum there are measures to de-radicalise people. Preventing people from becoming terrorists reduces the dependence on security measures. Gathering intelligence on terrorist suspects is a key area that could prevent attacks from taking place. It also has a role, as outlined above, in providing information on which security measures should be in place in the rail sector.

48) Intelligence led operations to intercept terrorist activities are another key area that can add value. It is also possible to reduce the impact

of an attack by being adequately prepared to deal with the consequences of a successful attack. In an open mass transit environment like rail, where it is arguably impossible to be one hundred percent confident of preventing an attack, consequence management is important. Overall therefore there is a suite of activities that together make rail transit safer.

Conclusion

- 49) The purpose of an economic appraisal should be to assist policy and political decision makers to make informed decisions. Assessments should therefore present the key financial findings, but also highlight risks and uncertainties, rather than making judgements for the decision maker. Unlike other areas of transport appraisal where economic models are regularly used there is currently no recognised methodology for decision makers when it comes to counter terrorism security.
- 50) It is possible to introduce certain aspects of economic assessment similar to those used in transport safety to assist the decision maker. These would be along the lines of a cost benefit analysis and value for money analysis. To do this would mean understanding the costs of any proposed security measures and the potential financial benefits if incidents are prevented by those measures. The economic benefits would depend on being able to prevent successful terrorist attacks on the rail network.
- 51) The potential savings would include people's lives, damage to infrastructure and service disruption at the micro level. There are already financial values for these; in the UK the estimated value within the transport department for a single life is roughly 1.3 million Euros, while damage to infrastructure and delay costs could also run into millions of Euros. At the macro level cost of lost international tourism and business confidence should be considered. The financial cost of these could easily run into hundreds of millions of Euros. Counter terrorism measures would also provide a benefit to general railway security and improving public confidence.
- 52) The attack scenarios that could be expected are many and varied. Therefore an operational analysis would be needed to determine what the likely impact is from the different forms of attack. This would provide some certainty on what damage would be caused to people and buildings should an attack be successful. However, as there are many different scenarios and methods of attack there would still be some uncertainty with any chosen scenario.
- 53) The predictability of terrorist incidents is where the real difficulty resides, and the lack of data is the crucial factor. Unlike policy interventions relating to safety, where there is normally a history of events this is not the case for terrorist attacks. This prevents a very

robust cost benefit analysis or value for money assessment from being undertaken using a single existing evaluation method.

- 54) Therefore some form of subjective analysis to determine the predictability of a terrorist attack and understand the risk is an option. By understanding the threat using information from the intelligence services, an examination of the vulnerability of the network to an attack and the likely impact of an attack a view could be taken on the risk and the likelihood of an attack.
- 55) The alternative to this is to concentrate on aspects where there is a degree of certainty. The actual financial costs of installing the security measures can be determined with a good degree of accuracy. With suitable analysis the financial cost can be ascertained of different terrorist scenarios.
- 56) Economic appraisal can be applied to security measures but there are significant limitations. The lack of data on the frequency of incidents means that a cost benefit analysis or value for money assessment cannot be completed without a degree of uncertainty. However, understanding the financial cost of a proposed measure will assist policy makers to make comparisons and decisions.

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**OSCE Economic and Environmental
Forum 24-26 May 2010 Prague**

Plenary Session VI

**Analysis and economic assessment
of rail transport security**

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This presentation aims to...

- Set out the rationale for using economic appraisal in transport security
- Examine the context of economic appraisal in counter terrorism railway security
- Examine the cost and benefits of security measures
- Cost benefit analysis
- Effective security measures in the rail environment
- Consider rail security as part of a wider counterterrorism environment
- Conclusions.

Rationale for economic appraisal

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- Will assist policy officials and business to make informed decisions
- There is a need to compare policy options in an analytical manner
- Appraisal is widely used in the transport sector e.g. safety, road schemes
- Business expectation – policy officials should know the cost of requiring security measures
- Increasing decisions are taken based upon economic values
- The current financial uncertainty will place greater scrutiny on decisions.

The context - economic appraisal in counter terrorism security

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- Transport is a known terrorist target – previous attacks on air and rail sectors
- The threat can vary across the sector – domestic, international and freight
- The threat can vary across different countries
- National and international terrorism and also extremist groups
- Terrorism threat is dynamic – CBRNE
- There is a comparison with a safety case but there are significant uncertainties.

Financial costs

- Implementing security measures - capital and operational costs
- Who pays - private or public sector cost – it is different across Europe
- Private sector – user pays principle
 - railways, passengers, associated businesses
- Public sector – public purse
 - regulating, policing, enforcement
- Accounting principles - optimism bias, cost of capital, depreciation, maintenance, training, net present values.

Financial benefits

- Benefits - Micro and Macro level
- Micro level
 - Preventing loss of lives, infrastructure damage, delay costs etc
- Macro level
 - Retaining confidence in financial markets
 - Retaining international tourism
- Operational analysis / scenario testing of incidents
- General crime benefits – serious crime, antisocial behaviour.

Cost benefit analysis

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- The main challenge in conducting a cost benefit analysis is to have sufficient data on past events to predict future trends
- Lack of data provides inherent uncertainty in any economic analysis
- There is some history – successful attacks on the railways, e.g. Madrid, London
- Using other sources of information i.e. from the intelligence services – but this is subjective and public transparency is an issue
- Terrorist events are high impact low probability events
- Is statistical confidence in predicting future events unrealistic?

Cost effective security

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- The mass transit environment - the rail network has unique challenges for effective security
 - These include ease of access to the rail network and its integration in the built environment
 - What level of delay, inconvenience, confidence would passengers accept?
- Proportionality -
 - Appropriate to types of service - domestic, international, freight
 - Appropriate level nationally, internationally
- Tolerability of risk -
 - Risk is a factor of threat, vulnerability and impact
 - ALARP used in H&S.

Other related issues

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- Deterrents - effective security measures should also deter terrorists and other criminals but this is very difficult to measure
- Displacement - effective security measures could change the threat type or move the threat to another sector
- Strategic initiatives
 - Protect – to strengthen our protection against terror attack
 - Prevent – to stop people from becoming terrorists or supporting violent extremism
 - Pursue - to stop terrorist attacks
 - Prepare – where an attack cannot be stopped, to mitigate its impact .

Conclusions

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- Economic appraisal of security measures should be used to assist policy makers to make informed decisions
- Certain aspects of cost benefit analysis and value for money appraisal can be applied to security measures
- Understanding the financial cost is relatively straight forward but quantifying the potential benefits is very difficult
- Lack of data and the dynamic nature of the terrorist threat are real obstacles to predicting incident rates and therefore robust benefits
- There is no existing economic model that fully meets the needs of counter terrorism security appraisal – this is the challenge!

**Thank you
&
Questions**