Project Preparation – building the resilient city through sustainable transport

by David Bray and Philip Sayeg (October 11-12, 2017, AIT, Bangkok)
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- Show how transport contributes to global agendas & implications
- Describe key aspects of transport project development – also relevant to other sectors
- Provide an understanding of the role of different actors
- Understanding risk assessment and role of public and private sectors

Timetable

Day/ time	Topic
Thursday 12 October	
09.00-10.30	Demand and economic appraisal
10.30-11.00	Break
11.00-12.00	Identifying risks and potential role of private sector
12.00-12.30	Wrap-up

Session 6: Urban Transport Evaluation/ Appraisal

- Estimating demand and economic benefits of sustainable transport measures
- Exercise in benefit estimation

A. Contents – Demand

- Context
- Demand estimation tools
- Fixed and variable demand
- Generalized cost
- Optimism bias

The quality of appraisal is a direct function of the quality of demand estimation

Strategic planning context

- Need to consider travel demand within a context that takes account of:
  - Current and forecast demography and land use
  - Transport policy settings
  - Transport strategy
  - Inter-related projects
  - Base case

Transport is a derived demand

- It is a means to get to your office, school, meet friends, go shopping, see a doctor, etc
- It is influence by:
  - the location of activities;
  - the available travel modes and features of them;
  - travel conditions; and
  - the time, financial resources and perception of travellers.
- All of these factors are variable
- Hence, the quantity and location of travel is not fixed

Demand is influenced by price

Fixed v's variable travel demand

- Key issues
  - Demand is influenced by a range of issues
  - A proposed project or policy initiative will influence demand – other than, perhaps, very small initiatives
  - Ignoring changes in travel demand will result in incorrect estimate of the economic benefits
  - It is more complex to estimate benefits with variable travel demand

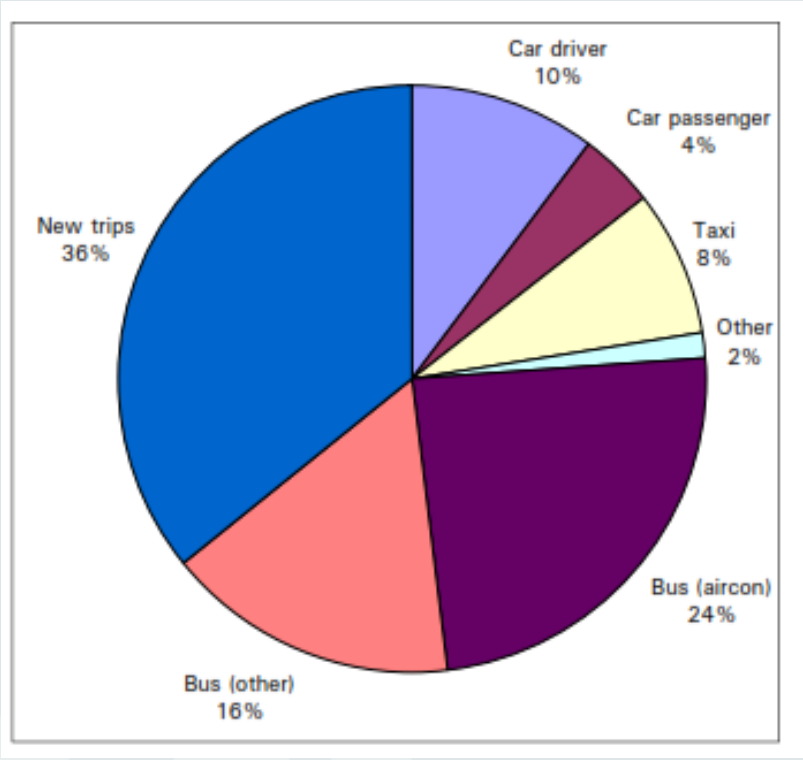
"there should be a presumption that the effects of variable demand on scheme benefits will be estimated quantitatively unless there is a compelling reason for not doing so"

(https://www.gov.uk/government/publications/webtag-tag-unit-m2-variable-demand-modelling-march-2017)

- Next slides
  - Where does demand for a new transit facility come from?

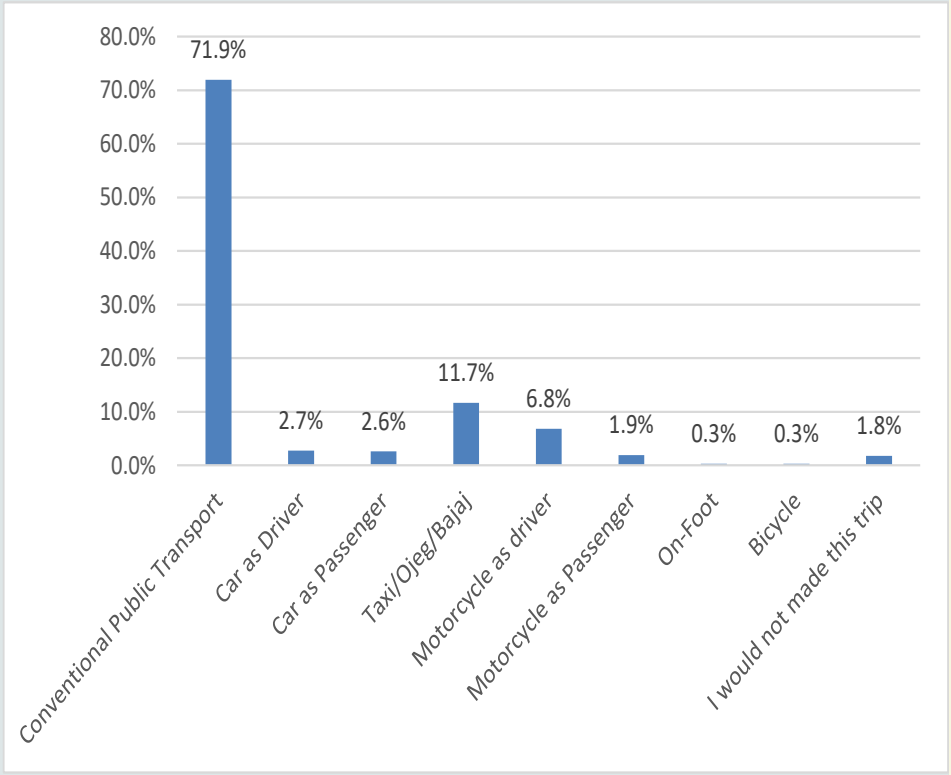
New public transport systems attract and generate patronage - 1

Bangkok Transit System – high transfer and generation



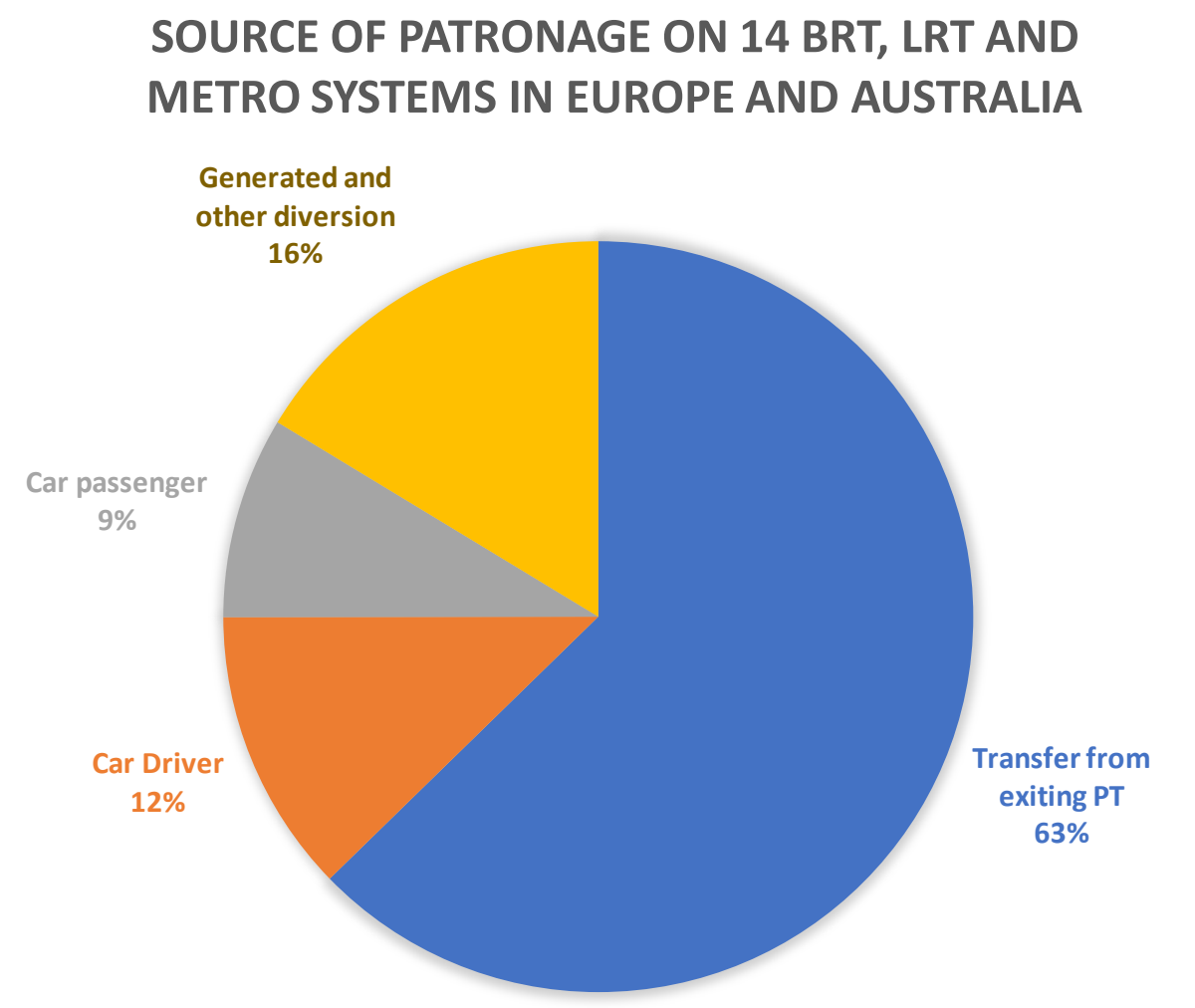
Source:
http://atrf.info/papers/2002/2002_Bray_Sayeg.pdf

Transjakarta BRT – stated alternative modes – typical for BRT



Source: http://docplayer.net/36136318-Post-evaluation-of-a-decade-of-experience-with-jakarta-s-transjakarta-bus-rapid-transit-system-abstract.html

New public transport systems attract and generate patronage - 2



Source: http://transportinfrastructurecouncil.gov.au/publications/

Two questions!

- Does the government have a strong influence the use of public transport?
- Are there ways its influence can be strengthened?

Demand estimation tools

Three general approaches

1. Simple projection
2. Elasticity based
3. Computerised travel demand models

1. Simple approach

- Projection based on historical (%) growth rate
- Long run projection of growth rates can result in very high forecasts
- Cannot take account of changes in factors affecting demand
- Hence, will be appropriate only in some very limited cases
  - e.g. small, short-term and simple projects

2. Elasticity based approach

- Indicates the likely change in demand given a change in an influencing factor
  - e.g. change in car use given a change in fuel price
- Draws on research into past changes in demand
- Show average response of the community
  - individuals are likely to respond differently
- Most data is for developed countries
- How transferable are elasticities?

Examples of elasticities

	Short Run (<12 months)	Long Run (5+ years)
Public transport demand with respect to (wrt):		
Generalised cost of public transport travel		
Public transport fares	-0.35	
In-vehicle time	-0.40	
Quantity of service (vkm)	0.40	
Cross-elasticity of demand		
Demand for car travel wrt public transport vkm	-0.10	
Demand for car travel wrt public transport fares	≈ 0.06	
Demand for pt travel wrt car variable costs	≈ 0.05	
Car travel (veh-km) wrt:		
Petrol price	-0.10	-0.3
Car in-vehicle travel time	-0.20	
Petrol consumption wrt petrol price	-0.25	-0.6

Examples of sources:http://transportinfrastructurecouncil.gov.au/publications/; http://www.vtpi.org/elasticities.pdf; https://www.pc.gov.au/inquiries/completed/urban-transport/37urbantv2.pdf; http://www.transport-research.info/sites/default/files/project/documents/trace.pdf; http://www.tandfonline.com/doi/abs/10.1080/0144164042000181725

Sources of data for elasticities

- Stated preference surveys
  - Need to be done with care – should not ask direct questions
- Revealed preference surveys
  - Look at how people responded to a change in the past
  - Can be difficult if other influencing factors occurred at the same time
- Behavioural modelling
  - Underpins behavioural economics

3 Computerised travel demand models

- Can cover all modes of transport, and both freight and passengers
  - Though pedestrian and cycling are generally less well covered
- Can indicate the combined effect of various policy, land use, demographic and transport system options
- Quality of the results of models depends on the quality of:
  - data on which the model is based – typically home interview surveys and travel diaries
  - the development of the model
  - the level of detail of the model
  - how well it is used

Computerised modelling of travel demand

	Can be modelled	Usually modelled
With constant land use, demography & travel demand:		
Change in route	✓	✓
Change in mode	✓	✓
Change in destination	✓	(✓)
Change in time	✓	✗
With change in:		
Land use	✓	(✓)
Demography	✓	✗
Travel demand	✓	✗

How do we model travel behaviour?

- Use the perceived cost of travel
  - Means for understanding the behaviour of travellers
  - Also called the ***generalized*** cost of travel
  - Takes account of:
    - Various components of travel time
    - Comfort and convenience
    - Out-of-pocket costs such as parking, fares and tolls
  - Expressed in a single unit, e.g. equivalent minutes or $
- Why is it important?
  - Affects trip generation, mode choice, origin and destination choice and route choice
  - Changes in perceived travel costs indicate the benefits considered by travellers

Components of perceived cost

Access Walk Time
- Valued at 50%+ more than actual time

Waiting Time
- Valued at twice actual time

Unexpected Waiting Time
- Valued at five times actual time

In Vehicle Travel Time
- Valued at actual time
- Valued at twice time if standing

Transfer Time
- Transfer Penalty to reflect the bother of needing to transfer (depends on the quality of the interchange)
- Plus walking, wait and unexpected wait time

Egress Walk Time
- Valued at twice actual time

People do not like unexpected waiting time and transfers in particular

Adapted from presentation by Professor Graham Currie to a Smart Urban Transport Conference in 2003

Example: Perceived cost for a public transport trip - 1

	Actual time (mins)	Weight-ing	Perceived cost (mins)	Share of actual time	Share of perceived cost
Walk	5	1.5			
Wait	3	2			
Fare ($2, VOT=$12/hr)					
In-bus	10	1			
Interchange					
Transfer time	3	2			
Transfer penalty					
In-train	20	0.8			
Walk	5	2			
Total	46				

Example: Perceived cost for a public transport trip - 2

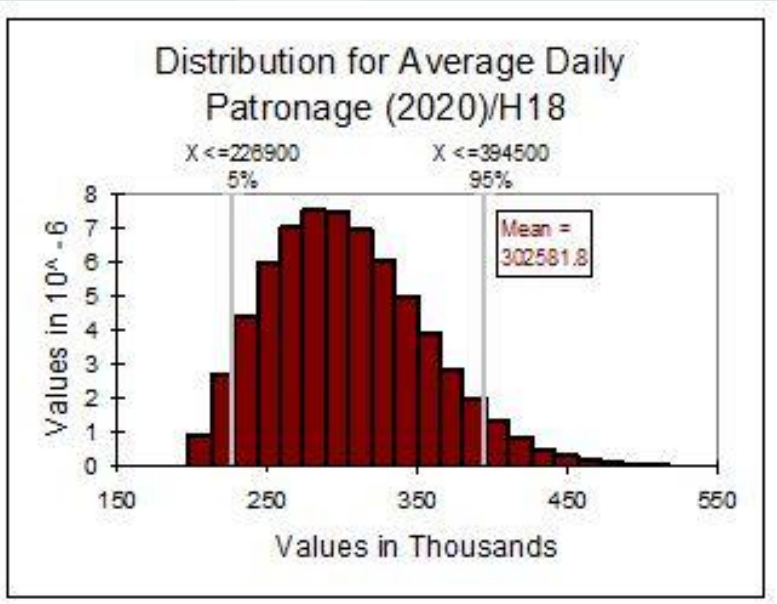
	Actual time (mins)	Weight-ing	Perceived cost (mins)	Share of actual time	Share of perceived cost
Walk	5	1.5	7	11%	9%
Wait	3	2	6	7%	8%
Fare ($2, VOT=$12/hr)			10	0%	13%
In-bus	10	1	10	22%	13%
Interchange					
Transfer time	3	2	6	7%	8%
Transfer penalty			10	0%	13%
In-train	20	0.8	16	43%	21%
Walk	5	2	10	11%	13%
Total	46		75	100%	100%

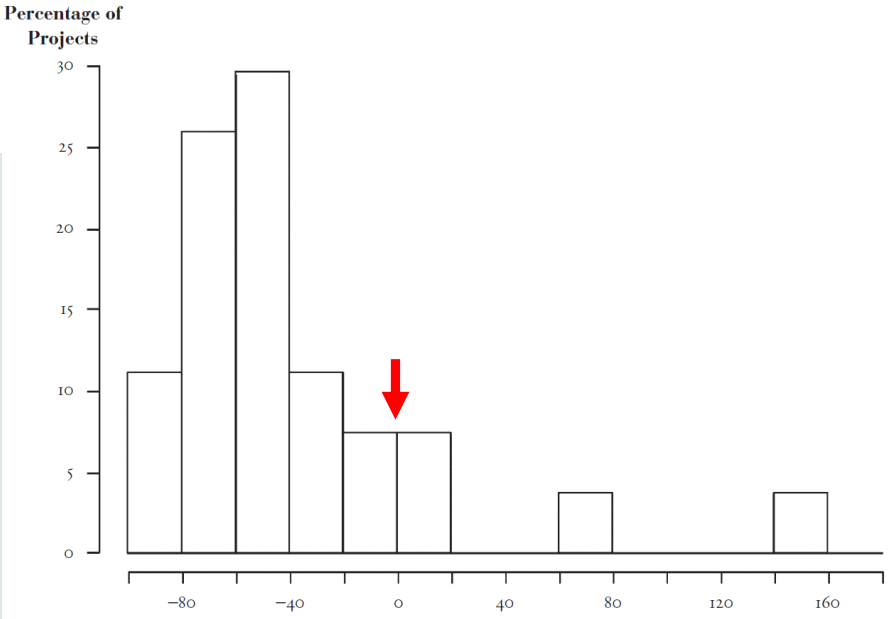
Example: Perceived cost for a public transport trip - 3

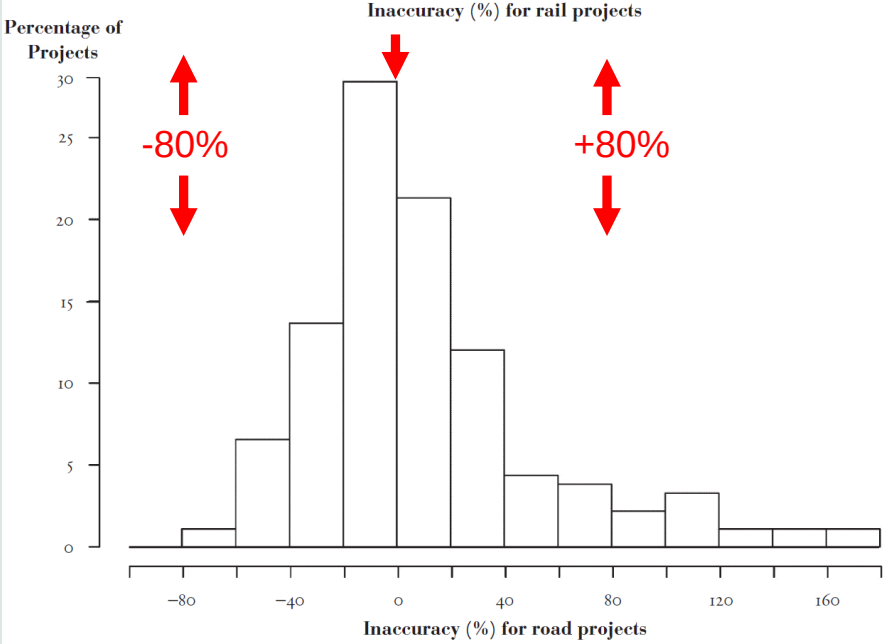
	Actual time (mins)	Weight-ing	Perceived cost (mins)	Share of actual time	Share of perceived cost
Fare			10	0%	13%
Walk	10		17	22%	23%
Wait	3		6	7%	8%
Interchange	3		16	7%	21%
In-vehicle	30		26	65%	35%
Total	46		75	100%	100%

Optimism bias

- Tendency to over-estimate demand
- Especially for public transport and fixed link projects

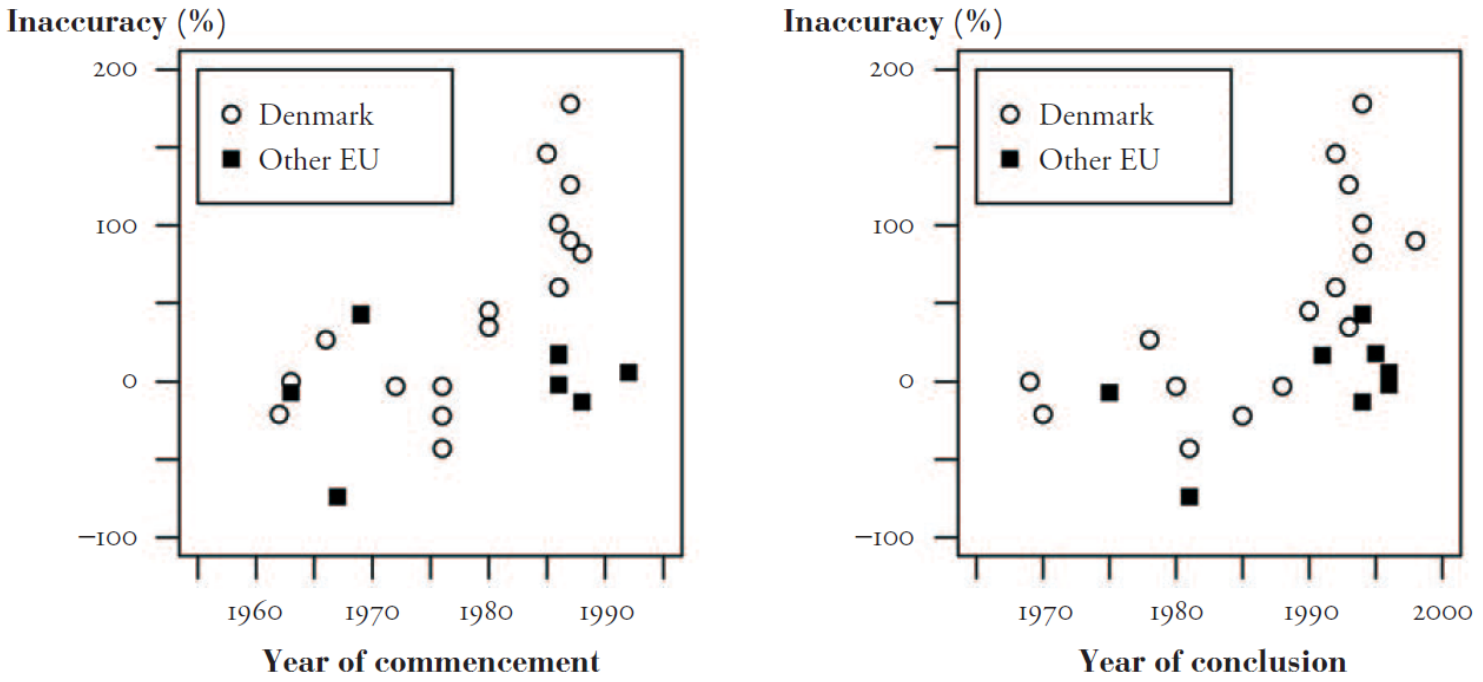






Source: http://flyvbjerg.plan.aau.dk/Traffic91PRINTJAPA.pdf

Optimism bias – error or lie?



Source: http://flyvbjerg.plan.aau.dk/Traffic91PRINTJAPA.pdf

Figure 4. Inaccuracy over time in forecasts of vehicle traffic in road projects (N=24).

- Inaccuracy has been increasing over time
- Result of poor quality or misleading technical work?

Forecast and actual demand for Asian urban rail systems

Example	Early demand (daily passenger boardings)		
1	216,000	17 months after opening	⅓ of opening forecast.
2	160,000	1 year after opening	⅓ of opening forecast
3	132,000	2 years after opening	70% of forecast (& after a major fare reduction)
4	60,000	2 years after opening	Around ⅓ of forecast
5	225,000	16 months after opening (420,000 10 years later)	Compares with forecast of 626,000

Source: http://www.worldtransitresearch.info/research/4445/

A question!

- Part of the problem with these metros are unrealistic demand forecasts.
- Are there other reasons why demand was low?

Correcting for optimism bias

- Improve the attention given to demand estimation
- Include allowance for risk of over-estimation
- Critically review forecasts
  - e.g. compare and rationalize forecast demand with experience for other similar projects
- Include sensitivity testing of the effect of alternative demand forecasts
  - And not simply, for example, ±10%

B. Contents – Economic benefits

- Purpose of economic evaluation
- What do we need for an economic evaluation
- Importance of the Base Case
- What generates benefits?
- Examples of economic benefits
- Valuing economic benefits
- Discussion
- Multi-criteria analysis

Social cost-benefit analysis was established in the 1950s and has been continually refined since - but the principles are unchanged.

Economic evaluation framework

- Objective of economic evaluation
  - To aid project prioritization and justification for an initiative
- It considers the
  - Incremental costs and benefits of an initiative
  - 'Social' costs and benefits – not financial effects
  - Expresses effects in a monetary unit - for convenience
- It does not formally take account of
  - Matters that cannot be quantified in monetary units
  - The distribution of costs and benefits, e.g. between people & regions
- Need to distinguish economic evaluation from financial, financing and budget evaluations
- Same process for sustainable transport as for any other transport initiative

What do we need for an economic appraisal?

- We need:
  - project costs
  - project benefits
  - over the appraisal period
  - in constant prices
  - a means to draw a conclusion from the information
  - consistency and explicitness
- Is this enough information? No – need to also consider:
  - compare the project with something – the Base Case
  - how certain can we be about input parameters?

Year	Costs	Bene-fits	Net benefit
1			
2			
..			
n			
Conclusion			

Importance of the Base Case

- Cannot evaluate a project in isolation:
  - Must compare it with another situation
  - Hence, need both
    - a Base Case (i.e. without the initiative)
    - a Project Case (i.e. with the initiative)

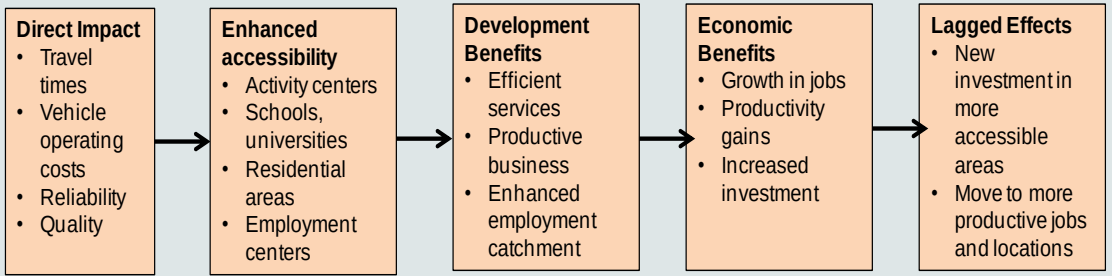
- $BCR = \frac{TravelCost_{bc} - TravelCost_{pc}}{ProvisionCost_{pc} - ProvisionCost_{bc}}$

- Implication
  - The Base Case affects the evaluation result just as much as the Project Case

What generates benefits?

- Economic benefits result from
  - Changes in travel demand and travel conditions
    - Plus consequent changes in the environment and economy
  - Improved amenity
  - Improved social accessibility
- Includes
  - Changes in resources
  - Changes in things that people value
  - Good and bad things, e.g. changes in environmental effects as well as direct transport effects
  - Things that take time to occur, e.g. effects on land use and economic productivity

From travel efficiency to economic benefits



Three categories of benefit

- Next slides consider
  - Commonly included items
  - Benefits sometimes included
  - Rarely included benefits

Commonly included benefits - 1

- For continuing users, i.e. with the same trip origin and destination, mode & time of travel
  - Reduced travel time (both personal travel and freight)
  - Improved reliability (especially for freight and public transport)
  - Reduced vehicle operating costs (VOCs) due to change in traffic conditions
  - Reduced road accidents
  - (Reduced environmental impacts)
- For users changing the mode of transport they use
  - As above, taking account of impacts for both the mode diverted from & the mode diverted to

Commonly included benefits - 2

- For users changing the origin and/or destination of their trip
  - As for continuing users, taking account of the benefit of being able to travel to between more attractive locations
- For time-diverted travellers
  - As for continuing users, taking account of the
    - Benefit from being able to travel at the preferred time
    - Disbenefit to people already travelling at the time diverting to
    - Benefit to people continuing to travel at the time transferred from
- For generated travel
  - Benefit of being able to make the trip
  - Less costs associated with the travel – not just time and VOCs
  - “rule-of-a-half” can be used to estimate perceived benefits

Economic benefits sometimes included

- Greenhouse gas emissions and local pollution
  - Data is available to allow their inclusion
  - Poor practice not to include them
- Wider economic impacts (WEIs)
  - Agglomeration economies, output change in imperfectly competitive markets and tax revenues from labour markets
  - Likely to be significant in only limited circumstances
  - Technical debate continues about the presence and valuation of WEIs
- What about land value?
  - Generally ‘no’ because changes in land value are a capitalization of other impacts

Rarely included economic benefits

- Land use densification
  - Can be captured by trip redistribution due to changed accessibility and land use development costs, but rarely done
  - However, PV of benefits is low as effects occur over the long term
- Amenity benefits
  - Examples include presence of public transport (even if not used) and enhanced local conditions such as improved footpaths
  - Some data available to support inclusion of amenity benefits
- Social impacts
  - Examples include
    - Improved access of disadvantaged people to social, support & economic activities
    - The distribution of costs and benefits between social groups
  - Limited research and data to support inclusion of efficiency benefits
  - Distributional issues considered in the 1970s, but not progressed

Valuing economic benefits - 1

- Travel decisions are based on the perceived cost of travel
  - For both private and public transport, the perceived cost of travel is usually less than the
    - Actual financial cost of travel
    - The social cost of their travel
  - Causes problems for estimation of demand and benefits
- Economic evaluation needs to take account of the social cost of travel
  - Therefore cannot base benefits solely on the cost of travel perceived by travellers
- With rare exceptions, taxes and subsidies are transfer payments and hence should be excluded from economic evaluations

Valuing economic benefits - 2

- Economic value of benefits
  - For items with a market price, e.g. fuel

    = Financial price minus tax plus subsidies
  - For items with an implied market price, e.g. CO_2

    = Market value
  - For items with observable effects, e.g. value of life, local air pollution

    = Estimated values based on economic analysis and contingent valuation
  - For items with a behavioural basis, e.g. travel time

    = Estimated values based on contingent valuation

Contingent valuation

Survey-based techniques for the valuation of non-market resources, e.g. stated and revealed preference surveys

Calculating benefits –introduction

- Number of ways to calculate benefits
  - Choice will be influenced by available input data & the understanding that is desired

5 ways to calculate benefits

1. Change in perceived user benefits plus resource costs
2. Perceived user benefits plus resource correction
3. Perceived user benefits with allowance for fare revenue
4. Social welfare approach
5. Consumer surplus plus producer surplus

They all give the same answer.

Table 3: Indicative example of alterative means for estimating the impacts of a public transport project

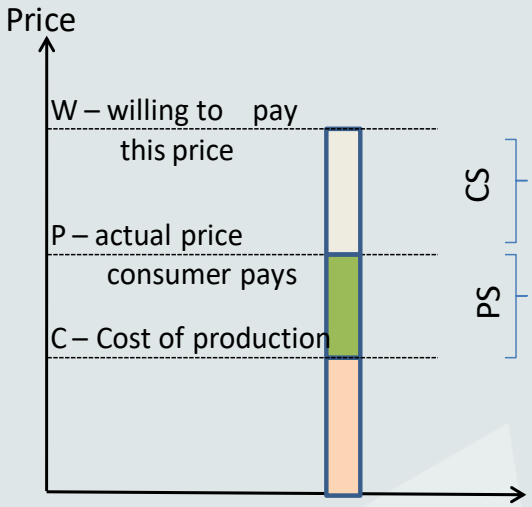
	Number of public transport trips	Unit resource cost of a public transport trip (cost/trip)			Unit perceived cost of using public transport (cost/trip)		
		Public transport supply cost	User cost (i.e. travel time)	Total	Fare	Travel time	Total
Base Case	100	12.0	9.0	21.0	3.0	10.0	13.0
Project Case	110	11.0	5.4	16.4	4.0	6.0	10.0

Table 4: Summary of benefits for a public transport initiative

Change in	Method 1 McIntosh and Quarmby	Method 2 Consumer surplus with resource correction	Method 3 Consumer surplus with allowance for fares	Method 4 ATC National Guidelines "Social Welfare" approach	Method 5 ATC Nat. Guidelines "Winners and Losers" approach
Perceived consumer surplus	315	315	315		
Perceived user costs	-200				
Resource costs	296				
Unperceived resource costs		96			
Incremental supply cost			-10		
Unperceived user benefits			-34		
Incremental fare revenue			140		
Social cost in the Base Case				2,100	
Social cost in PC – existing traffic				-1,640	
Social cost in PC - generated traffic				-164	
Change in WTP for travel				115	
Consumer surplus					281
Producer surplus					130
Total user benefit	**411**	**411**	**411**	**411**	**411**

Source: http://atrf.info/papers/2007/2007_Bray_Tisato.pdf

Calculating benefits – Method 5



- Consumer surplus (CS) is the benefit a consumer gets from consuming a good less the price of the good
- Producer surplus (PS) is the price of a good less the cost of production

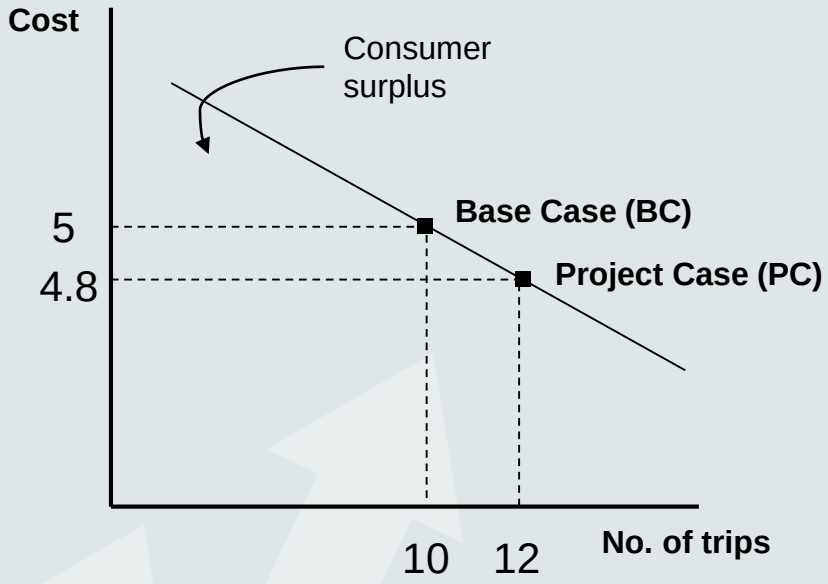
Base Case

- Input data
  - 10 travellers
  - Av. user value (W) = 6
  - Cost of travel (P) = 4
  - Cost of prod'n (C) = 3
- Value
  - Consumer surplus (CS) = 10 * (6 – 4) = 20
  - Producer surplus (PS) = 10 * (4 – 3) = 10
  - Total surplus = 30

Project Case

- Input data
  - 12 travellers
  - Av. user value = 5.9
  - Cost of travel = 3.8
  - Cost of prod'n = 3
- Value
  - Consumer surplus = 10 * (5.9 – 3.8) + 2 * (4-3.8)/2 = 21.2
  - Producer surplus = 12 * (3.8 – 3) = 9.6
  - Total surplus = 30.8

Calculating benefits – Methods 1&2
(resource cost > perceived cost)



	Base Case	Project Case
No. of travellers	10	12
Perceived cost	5	4.8
Resource cost	7	6.8

- Perceived benefit
  - For Base Case users = 10 * (5 – 4.8) = 2
  - For new users = 2 * (5 – 4.8) /2 = 0.2
- Unperceived benefit
  - Unperceived resource cost in PC = 12 * (6.8 – 4.8) = 24

  less
  - Unperceived resource cost in BC = 10 * (7 – 5) = 20
- Total benefit =

  (2 + 0.2) + (24 – 20) = 6.2

Typical scale of economic benefits

Item	Monetized	% of total monetized benefits
Travel time	Yes	Up to 50%
Vehicle operating costs	Yes	Up to 50%
Induced traffic	Yes	< 10%
Service quality of PT	Can be included in time savings	Up to 20%
Crash costs	Yes, usually	<10%
Environment	Can be, but commonly not done	Usually < 5%
Traffic congestion	Usually through travel time, VOC and induced traffic effects	
Accessibility	Partially captured in travel time & VOC savings	

Examples of BRT benefits

	Present value of selected economic benefits of 4 BRT schemes (US$ million, 2012 prices)					
Benefit	Trans-Milenio, Bogota (Phases 1-2)	Metrobus, Mexico City (Line 3)	Rea Vaya, Johannes-burg (Phase 1A)	Metrobus, Istambul (Phases 1-4)	Total	Share
Travel time savings	1,830	142	331	6,369	8,672	55%
Operating cost savings	1,393	38	179	2,154	3,764	24%
Improved road safety	288	23	268	881	1,460	9%
Health benefits of incr-eased physical activity	999	7	141	392	1,539	10%
Benefits from reduced carbon emissions	239	10	18	152	419	3%
Total	4,749	220	937	9,948	15,854	100%

Source: http://www.wrirosscities.org/sites/default/files/Social-Environmental-Economic-Impacts-BRT-Bus-Rapid-Transit-EMBARQ.pdf - as reported in https://files.lsecities.net/files/2014/11/LSE-Cities-2014-Transport-and-Urban-Form-NCE-Cities-Paper-03.pdf

Three questions!

1. What is your view on the size of the economic value of environmental benefits?
2. Do we also always need economic evaluation e.g. when the problem is obvious and the solution is cheap?
3. Are there alternative evalution approaches?

Multi-criteria analysis

- Intuitively attractive
- Multi-score and single score approaches
- But limitations
  - No sound theoretical basis to support it
  - Risk of overlapping criteria & inconsistent criteria
  - Scoring challenges
  - Difficult to include time preference rate
  - Cannot establish absolute merit
- Better approach
  - Present economic evaluation within a multi-criteria framework

Small group exercise – respond to the following questions

1. What questions would you ask the consultant who prepared the patronage forecast for an LRT project or another major project so that you can judge if the forecast is reasonable?
2. Why are patronage forecasts for new public transport infrastructure projects often excessively optimistic?
3. Is it possible for land use in Asian cities to change to take account of a new metro? What is needed to allow it to happen?
4. Is economic evaluation is a good way to measure the benefits of an initiative? How might it be improved?
5. Is multi-criteria analysis is a better way to assess an initiative?
6. Do sustainable transport projects need to be evaluated in a different way to other transport projects?
7. Can sustainable transport projects be evaluated in the same way as other transport projects?

Session 7: Risk Analysis and Opportunities for Private Sector Participation

- Risk identification, analysis, evaluation, treatment and management
- Private sector participation
- Risk allocation
- Wrap-up

A. Contents – Risk

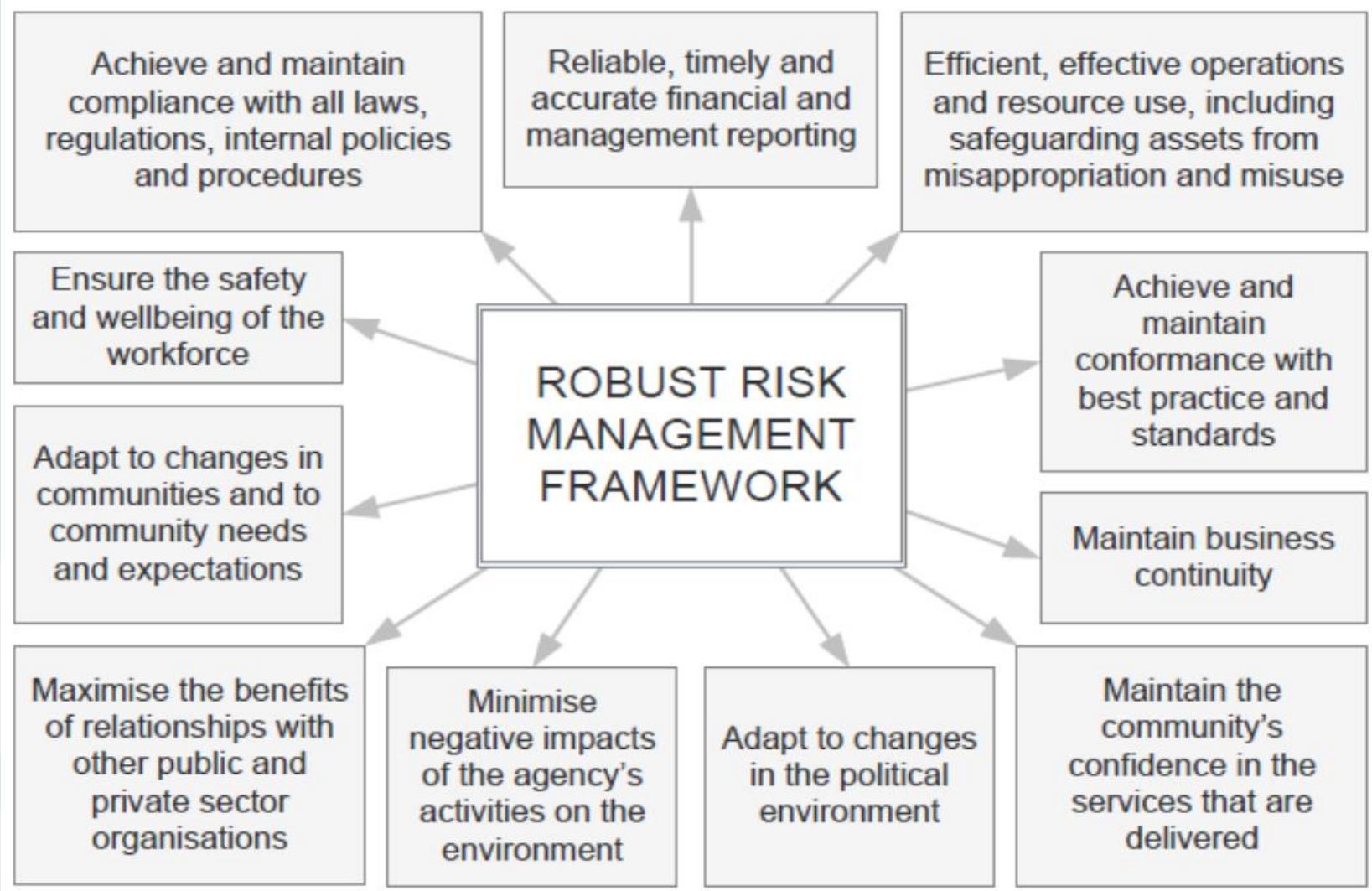
- Risks in procurement of public infrastructure and services
- Private sector participation in public infrastructure and services
- Allocating risks to achieve improved outcomes
- Discussion

Risk compromise initiatives

Risk identification & management

- What are risks?
  - Opportunities for things to go wrong
  - They result from uncertainty and poor practice
- Why bother?
  - **Risk can result in higher costs, lower benefits and more troublesome implementation**
- What is risk management?
  - Process to identify and assess risks, followed by actions to monitor and control their likelihood and their impact
  - Effort needs to be proportional to the level & consequence of the risks (e.g. prepare RM plan for investment >$0.5m?)
  - Needs a formal approach and be appropriately quantitative

Benefits of risk management



Source: https://www.treasury.nsw.gov.au/information-public-entities/governance-risk-and-assurance/internal-audit-and-risk-management/risk

Risk is relevant to all stages of procurement

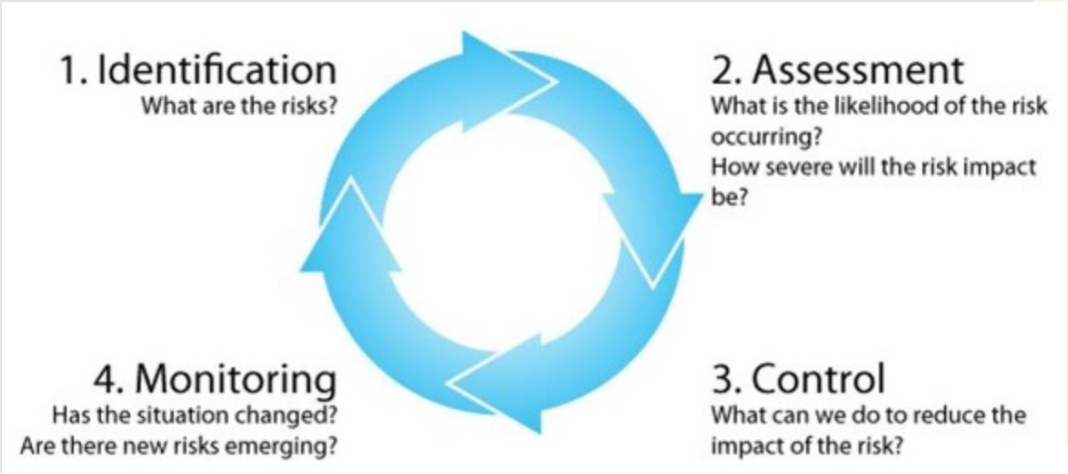
Stages of procurement

1. Identifying the need and planning the purchase
2. Developing the specification
3. Selecting the procurement method
4. Preparing procurement documentation
5. Securing offers
6. Evaluating offers
7. Selecting the successful tenderer
8. Negotiations and contracting
9. Contract management
10. Post-procurement evaluation

Risk management process

ISO 31000

A set of principles, frameworks and processes aimed at improving decision making about risks and their management by reducing uncertainty and increasing the likelihood that organisational objectives will be achieved (NSW Treasury)



Sources:

https://www.procurementjourney.scot/risk-management-process

http://broadleaf.com.au/resource-material/risk-management-for-major-procurements/

Stage 1: Risk identification

- Identify all potential risks associated with each stage of procurement
- Different sources identify a wide range of risks
  - i.e. there is no good standard register of risks

Risk identification - example 1

<table>
<tr><th>Risk Categories</th><th>Development Phase</th><th>Construction Phase</th><th>Operation Phase</th><th>Termination Phase</th></tr>
<tr><td rowspan="6">Political and regulatory</td><td>Environmental review</td><td>Cancellation of permits</td><td rowspan="2">Change in tariff regulation</td><td>Contract duration</td></tr>
<tr><td rowspan="2">Rise in pre-construction costs (longer permitting process)</td><td rowspan="2">Contract renegotiation</td><td>Decommission</td></tr>
<tr><td>Asset transfer</td></tr>
<tr><td colspan="3">Currency convertibility</td></tr>
<tr><td colspan="4">Change in taxation</td></tr>
<tr><td colspan="4">Social acceptance</td></tr>
<tr><td colspan="4">Change in regulatory or legal environment</td></tr>
<tr><td colspan="4">Enforceability of contracts, collateral and security</td></tr>
<tr><td rowspan="5">Macroeconomic and business</td><td>Prefunding</td><td colspan="3">Default of counterparty</td></tr>
<tr><td colspan="2" rowspan="3">Financing availability</td><td colspan="2">Refinancing risk</td></tr>
<tr><td colspan="2">Liquidity</td></tr>
<tr><td colspan="2">Volatility of demand/market risk</td></tr>
<tr><td colspan="4">Inflation</td></tr>
<tr><td colspan="4">Real interest rates</td></tr>
<tr><td colspan="4">Exchange rate fluctuation</td></tr>
<tr><td rowspan="6">Technical</td><td colspan="3">Governance and management of the project</td><td rowspan="5">Termination value different from expected</td></tr>
<tr><td colspan="3">Environmental</td></tr>
<tr><td>Project feasibility</td><td rowspan="2">Construction delays and cost overruns</td><td rowspan="2">Qualitative deficit of the physical structure/ service</td></tr>
<tr><td>Archaeological</td></tr>
<tr><td colspan="3">Technology and obsolescence</td></tr>
<tr><td colspan="4">Force majeure</td></tr>
</table>

Source: https://www.oecd.org/g20/topics/development/Report-on-Risk-and-Return-Characteristics-of-Infrastructure-Investment-in-Low-Income-Countries.pdf

A question!

- For the first stage of procurement

  Identifying the need and planning the purchase

  What are some risks associated with this stage?

Risk identification - example 2

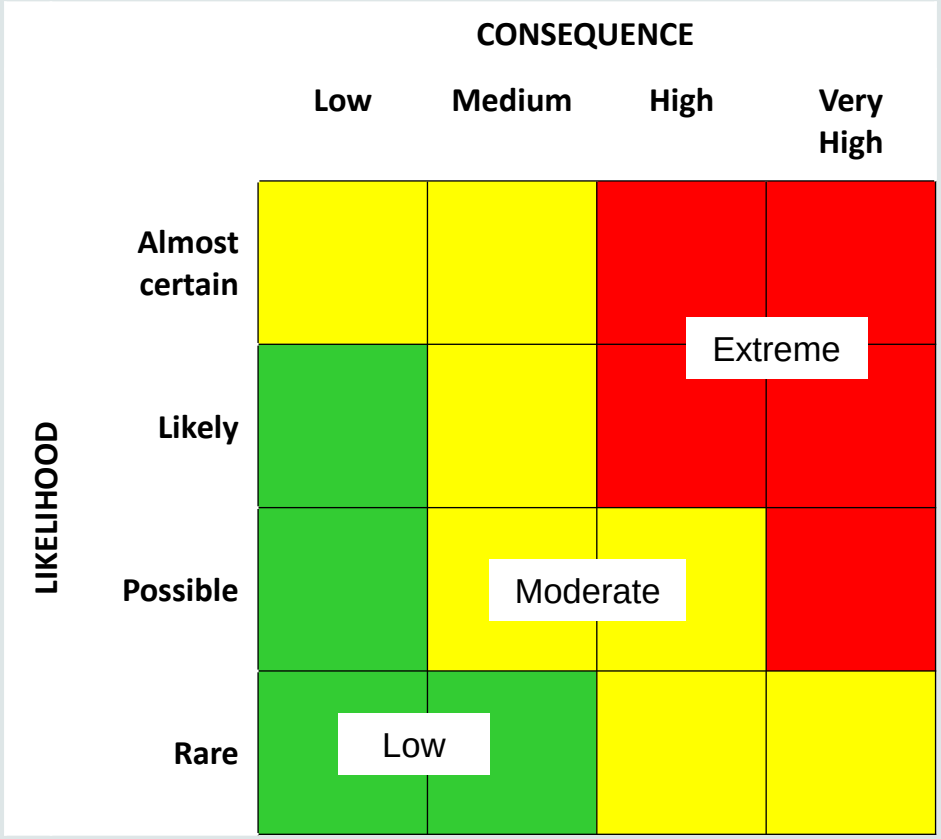
- Risks associated with, for example, the "Identifying the need and planning the purchase" stage of procurement can include
  - Mis-specification of the project
  - Impractical timeframe
  - Unrealistic cost expectations
  - Insufficient funding
  - Delays in obtaining approvals
  - Delays in securing land
  - Poor understanding of organisational requirements and stakeholder needs & issues
  - Inadequate understanding of the supplier market
  - Incorrect contracting model selected
  - Incorrect market approach selected

Stages of procurement

1. Identifying the need and planning the purchase
2. Developing the specification
3. Selecting the procurement method
4. Preparing procurement documentation
5. Securing offers
6. Evaluating offers
7. Selecting the successful tenderer
8. Negotiations and contracting
9. Contract management
10. Post-procurement evaluation

Stage 2: Risk analysis

- Determine the probability and consequence of each risk
  - Take account of practices built into current procedures to establish the need for change
  - Common to identify three categories of risk – low, moderate and extreme



Example of risk analysis - 1

Risk Category	Cause	Consequence	Likelihood	Probability %			Minimum (£)	Most Likely (£)	Maximum (£)	Estimated Value (Pert)
Procurement	Inappropriate procurement structure selected / tender rates not achieved	Contractors include significant price premium in commercial tenders. Liabilities for consequential losses lie with client	2	Medium	35%	65%	£150,000,000	£300,000,000	£600,000,000	£162,500,000
Market Context	Construction industry resources (e.g. tunnelling contractors, concurrency of major projects (Crossrail, other railway projects)	Increased tender prices. Delay whilst await for available resource	2	Low	5%	35%	£350,000,000	£700,000,000	£1,400,000,000	£151,666,667
Statutory Consultees (Technical)	Rail company disruption greater than planned	Increased Cost to project	2	Medium	35%	65%	£100,000,000	£250,000,000	£500,000,000	£135,000,000
Statutory Consultees (Technical)	Rail company objection to scheme details (e.g. parallel running, junction configuration)	Programme delay whilst rework. Cost of redesign and associated works	3	Medium	35%	65%	£100,000,000	£200,000,000	£400,000,000	£108,333,333
Utilities	Unknown buried services	Increased cost of protection or diversion	3	Medium	35%	65%	£100,000,000	£200,000,000	£300,000,000	£100,000,000
Geotechnical	Uncertain ground conditions	Cost of ground improvements higher than expected. Cost of alternative design	3	Medium	35%	65%	£100,000,000	£200,000,000	£300,000,000	£100,000,000
Statutory Consultees (Technical)	Statutory technical approval bodies require additional assurances	Approvals take longer than expected Cost of mitigations (e.g. additional station)	3	Medium	35%	65%	£50,000,000	£100,000,000	£200,000,000	£54,166,667
Environmental	Extent and activity of contaminated land different from expected	Cost of treatment and disposal	3	Medium	35%	65%	£75,000,000	£100,000,000	£150,000,000	£52,083,333
Constructability	Contractor questions constructability of design	Associated costs higher than expected. Programme delay associated with alternative methods	2	Low	5%	35%	£120,000,000	£240,000,000	£360,000,000	£48,000,000
Non-Statutory Stakeholders	3rd party objections to construction methodology	Delay owing to restricted working hours. Cost of more expensive methods	2	Low	5%	35%	£120,000,000	£240,000,000	£360,000,000	£48,000,000
Environmental	Unexpected discovery of archaeological artefacts	Cost of expert investigation. Programme delay whist investigate	2	Low	5%	35%	£120,000,000	£240,000,000	£360,000,000	£48,000,000
Project Scope	Interfaces with proposed developments (e.g. BAA , LUL, Crossrail, HS1, other railways). Terminal points unclear	Cost of scope changes to integrate with interfacing schemes	2	Low	5%	35%	£100,000,000	£200,000,000	£400,000,000	£43,333,333
Railway Technology	Emerging technical equipment unavailable in time (e.g. ERTMS)	Cost of modifying scheme to match available technology Programme delay whilst rework design	2	Low	5%	35%	£100,000,000	£200,000,000	£300,000,000	£40,000,000
Railway Technology	Obsolescence of technical equipment (e.g. GSM switched off)	Cost of providing replacement/alternative equipment. Applies to pre-construction phase	2	Low	5%	35%	£100,000,000	£200,000,000	£300,000,000	£40,000,000
Optioneering	Unreliable optioneering process (e.g. options mistakenly parked) owing to for example insufficient EIA (significant environmental issue overlooked)	Cost of rework and associated delays Adverse effect on HS2 reputation	2	Medium	35%	65%	£5,000,000	£75,000,000	£150,000,000	£37,916,667
Input data	Incorrect input data leads to incorrect scope definition	Cost of redesign and associated works	3	Medium	35%	65%	-£50,000,000	£75,000,000	£200,000,000	£37,500,000
Land	Additional commercial property at risk due to proximity to rail corridor	Acquisition of additional properties (and subsequent resale potential?)	2	Medium	35%	65%	(£40,000,000)	£50,000,000	£156,000,000	£26,333,333
Land	Uncertain land acquisition costs	Land costs higher than expected. Legal process delays land take	3	Medium	35%	65%	(£30,000,000)	£50,000,000	£120,000,000	£24,166,667
Traction Power	Additional cost incurred connecting to National Grid / additional cabling required	Additional power supply scope / cost / redesign	2	Medium	35%	65%	20000000	£40,000,000	£100,000,000	£23,333,333
Waste	Waste regulation changes	Related costs of treatment/disposal higher than expected	2	Low	5%	35%	£50,000,000	£100,000,000	£150,000,000	£20,000,000
Design Standards	Changes in standards (e.g. TSIs) during design lifecycle	Cost of designing to alternative standards	2	Low	5%	35%	£30,000,000	£50,000,000	£75,000,000	£10,166,667
HS&E Standards	H&S standards change	Cost of mitigation (e.g. clearances, safety fencing) increases	2	Low	5%	35%	£30,000,000	£50,000,000	£75,000,000	£10,166,667
Environmental	Adverse effect of noise and vibration	Floating slab track required in tunnels and restricted choice of viaduct solutions	3	Medium	35%	65%	£10,000,000	£20,000,000	£30,000,000	£10,000,000
Project Scope	Enabling works delayed or cancelled (e.g. LUL)	Cost of enabling works borne by HS2	2	Low	5%	35%	£20,000,000	£40,000,000	£60,000,000	£8,000,000
Design Standards	Major incident on HSL	Alteration of standards introducing rework at increased cost Higher cost of risk financing (e.g. insurance cover)	4	Minimal	0%	5%	£50,000,000	£150,000,000	£250,000,000	£3,750,000
Constructability	Efficiencies in construction of elevated structures	Elevated scope cost reduced	2	Medium	35%	65%	(£150,000,000)	(£75,000,000)	£0	(£37,500,000)
Procurement	Continental construction rates achieved	Tender prices reduced	2	Low	5%	35%	(£1,500,000,000)	(£100,000,000)	(£50,000,000)	(£65,000,000)

For High Speed Train 2 Phase 1 , United Kingdom– Project Level Risks.

Source: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69741/hs2-cost-and-risk-model-report.pdf

First item in previous table

Item 1	Analysis result
Risk Category	Procurement
Cause	Inappropriate procurement structure selected/tender rates not achieved
Consequence	Contractors include significant price premiums in commercial tenders. Liabilities for consequent losses lie with client.
Likelihood	2 (= Medium, i.e. where harm will often occur)
Probability	Medium
Cost implications:	
Minimum	£150m
Most Likely	£300m
Maximum	£600m
Estimated Value	£162.5m

Stage 3: Risk evaluation

- Make decisions on which risks
  - Need to be treated
  - Can be tolerated with appropriate management
  - Can be accepted subject to monitoring
- Prioritize the risks to be treated

	Consequences		
Likelihood	Minor	Moderate	Major
Likely			
Possible			
Unlikely			

Risk Treatment Key

Intolerable Risk Level. Immediate action required
Tolerable Risk Level. Risks must be reduced so far as is practicable.
Broadly Acceptable Risk Level. Monitor and further reduce where practicable.

Stage 4: Risk treatment

- Identify additional means to manage the identified risks
- Determine the most cost-effective approach(es)
- Prepare a formal plan to manage risks

Action	Application	Example Treatment
Accept or Retain the Risk	When the risk impact is minimal to insignificant and exceeds the cost of controlling or eliminating the risk. When the risk cannot be avoided or transferred or the cost to do so is prohibitive.	Employ appropriate risk mitigation strategies to manage the risk.
Avoid the Risk	When the impact of the risk is unacceptable and must be avoided.	Do not commence or continue to undertake the activity that gives rise to the risk. Seek alternative ways to achieve the outcome.
Transfer the Risk	Shift responsibility from the organisation to another party who will bear the consequences if the risk arises. Note that responsibility should be borne by the party best able to control and bear that risk.	Insurance policies and/or contractual agreements with third parties.
Reduce the Likelihood and/or Consequences of Occurrence	When the risk has to be accepted, implement changes or alternatives to minimise the likelihood of the risk occurring and/or its consequences.	Clarify contract terms, requirements and specifications. Specify professional accreditation. Upgrade supervisory requirements.

http://www.spb.sa.gov.au/sites/default/files/Risk%20Management%20Guideline%20v5.0%20September%202016_0.pdf

Stage 5: Risk monitoring

- Maintain oversight of each significant risk
  - Ensure risk management plan is implemented
  - Identify emerging issues with identified risks and potential new risks
  - Implement remedial measures as needed to minimize the probability of the risks coming to fruition
  - Continue through the entire procurement process, including post-completion review

Private sector participation

- Why consider private sector participation (PSP) in contracts issued by government?
- Models for PSP
- Why consider PSP in the financing of public infrastructure?
- Risks associated with PSP

What is a PPP

"a long-term contract between a private party and a government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility, and remuneration is linked to performance“

http://ppp.worldbank.org/public-private-partnership/overview/what-are-public-private-partnerships

Why consider PSP?

- For the moment, exclude private sector financing of public infrastructure
- Take the case of construction and supply of equipment and services
  - Will almost always be necessary to some extent to involve the private sector because government rarely has expertise to supply all infrastructure, equipment and services
  - Careful transfer of risk to the private sector can result in better management of the risk - leading to lower cost and better quality outcomes

The rule to guide risk transfer

- Common guidance
  - "Allocate risk to the party best able to management it"
  - This is inadequate as some risks cannot be managed by either party, e.g. macro-economic risk in the case of a sub-national government
- Better rule
  - "Transfer risk to the private sector that they can manage"
  - Residual risk remains with government
- Effect of more transfer to the private sector than this
  - There is reduced interest in bidding, and hence poorer outcomes
  - The private sector may include an extra amount in tenders to allow for risks that they cannot manage, i.e. costs↑
  - There is incentive for undesirable practices as the private sector seeks other ways to remediate the risk, i.e. costs↑ and quality↓
- Effect of a lesser transfer of risk to the private sector
  - No incentive for the private sector to manage the risk, i.e. costs↑, quality↓

PSP models (without PSP financing)

- Leave aside
  - Conventional infrastructure & equipment supply contracts
    - These are generally well-understood
  - Contracts for commercial (i.e. profitable) services –
    - Government provision will generally be more costly and hence private sector provision is preferred (within an appropriate regulatory framework if necessary)
- Consider the supply of non-commercial (i.e. subsidized) services that government wants
  - e.g. public transport services
  - These may/may not involve user charges
  - But focus on instances with some user charges

Contracts for private sector (PS) supply of subsidized urban public bus service (excl. capital)

	Gross Cost contract	*Net Cost* contract
Payment to contractor	Payment covers the total cost of the service to be provided (e.g. $X/quantity of service provided)	Payment covers the difference between the cost of the service t to be provided and revenue collected (e.g. $Y/quantity of service provided, where $Y < $X)
Risk transfer – costs	Risk can be transferred to minimize overall costs (e.g. payment = $/bus + $/bus-hour + $/bus-km, with agreed indices to allow for inflation)	Similar, but $/bus-hour and $/bus-km rates would be lower than for Gross Cost contract after allowing for fare revenue collected by the PS
Risk transfer - revenue	Patronage (i.e. revenue) risk remains with government	Patronage (i.e. revenue) risk is transferred to the PS
Example - Issues with transfer of revenue risk	If all patronage risk remains with government, the PS has no incentive to provide good services. Solution is to lower $/bus-hour &/or $/bus-km rates and add a component of the payment that is linked to patronage.	PS bus operator does not have full control over patronage, e.g. it is also influenced by other government policies, macro-economic conditions, traffic congestion etc. No easy solution.

Why consider PS financing?

- What about private sector (PS) financing of public infra?
- Common reason given for this is a shortage of government finance – is this reasonable?
- Guidelines for technical analysis of private sector financing indicate that it should be used rather than government financing where it results in lower overall cost to the government on a risk-adjusted basis
- What does this mean in practice?
  - The cost of PS capital is higher than the cost of government debt
  - There is a need to transfer risks to the PS that the PS can manage better than government, with a need that the resulting financial benefits exceed the higher cost of PS capital
- If this isn't done, the government will pay a higher overall price for PS financing than implementing the project itself

Where have PPPs been successful?

- Mostly in
  - Energy sector, where commercial investment is possible
  - Expressways, airports and ports, where substantial revenue can be collected. (Governments sometimes provide a contribution to the investment.)
  - Occasionally in metros, but clouded by limited transparency
- But many examples of failed transport PPPs
  - Mostly due to over-optimistic demand/revenue forecasts
  - Also inadequate government capacity to manage contracts
- Unsolicited PPPs are undesirable
  - Don’t necessarily reflect public priorities
  - Absence of competition likely to result in higher costs

Selected options for PSP in urban metro

Source: http://www.worldtransitresearch.info/research/4445/

Feature	A. Public implement-ation & operation	B. Public implementation of infrastructure, plus an operating concession	C. Public supply of fixed infra, plus a train supply & operating concession	D. Public financing of fixed infra, plus a concession for trains, construction & operations	E. Private finance, design, build, operate and transfer
1. Delivery					
Civil works	Private sector under contract to the government			A single private sector consortium	
Trains/train control	As above		A single private sector consortium		
Train services & infra. maint.	Negotiated agreement	As above			
Ticket system		Ticket system and revenue management – either by government or contracted out			
2. Financing					
Civil works	Capital is provided by the government				Capital from concessionaire. Govt. pays for O&M and capital through contract
Trains/ control	Government capital		Capital for trains from concessionaire. Govt. pays for O&M and capital for fixed infrastructure through contract		
Train services & infra. maint.	Govt. directly pays for costs	Govt. pays for O&M through contract			
Fare Revenue	To government				
3. Risk Transfer	Limited transfer of risk	Some operating risk remains with the government. Can transfer some patronage risk.	As for Option B, but most operating risk is transferred to the concessionaire	More transfer of risk to the concessionaire than in Option C	Transfers a little more risk than Option D but incurs higher cost of capital.

Discussion

1. What risks associated with private sector participation in the development and operation of a BRT line are of most concern to you?
2. Should an operator of a BRT line also supply the buses to be used and associated depots?
3. What actions are needed to allow government to establish and manage an effective contract with the private sector for the financing and operation of a LRT or BRT?