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Disruption Costs in Bus Contract Transitions

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TITLE: **Disruption Costs in Bus Contract Transitions**

ABSTRACT:

This paper investigates the role of assessment criteria in assisting members of the competitive tendering evaluation committee to choose their preferred operator, be it the incumbent or a new operator. In a world where there are increasing numbers of jurisdictions moving to competitive tendering for their land based public transport, there is an increased incidence of a change in operator when the term of the contract comes to an end. In many jurisdictions, the anecdotal evidence on the disruption caused by this change in operator is growing. Is there a danger that Government decides to stay with a bad outcome because previous experience with transition was bad? Or conversely, might Government opt for a transition simply on the basis of the bid offer price without taking account of the transaction (especially disruption) costs involved for government, operator and the travelling public? We investigate this issue using a stated choice experiment in which members of evaluation committees are presented with a series of alternative operator bids that include, ex ante, a measure of the transition costs identified as a proportion of the lowest offer for the contract, and two proxy descriptors of operator reputation. The outcome of the experiment is modelled as a mixed logit choice model to identify the role that the transition costs play in influencing the preferences of evaluation committee members, providing evidence for the first time on the extent to which the often unreported role of such transition costs, perceived or real, appear to play in the minds of competitive tender evaluation.

KEY WORDS: ***Contract transition, Disruption costs, Stated choice, Offer assessors, Mixed logit, Bus contracts***

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1. Introduction

There is much discussion about the presence of transaction costs imposed on the operator and the regulator associated with both competitively tendered and negotiated bus contracts when an incumbent is unsuccessful and a new operator takes over. Specifically, it is suggested that the elements of quality and reputation of a bidder is not taken into account in respect of their reputation and history of success or otherwise in service delivery under various contract regimes when tender bids are evaluated. These elements may well be a proxy for the ability to minimise the transition costs by the operator winning the contract, over and above their own private transition costs, Although an experienced operator will factor their private transition costs into their offer price (and amortise these over the life of the contract), there will nevertheless be a set of additional costs that are incurred by government and service users resulting from a change in operator. These range from potential labour disruption from changes in take home wages or contracts, additional contract negotiation costs[1], and service changes that create concerns for passengers as the new operator finds their feet in terms of route and service knowledge. Whilst some of these impacts cannot be easily measured in dollar terms, they can at least be included in a benefit assessment using a formal preference model that expresses these influences (in aggregate) as an additional source of loss of service value.

To demonstrate the importance of this topic, we use an example centred on the value for money idea that government promotes to justify competitive tendering (Hensher and Stanley 2010) to show why accounting for transition costs that are not internalised by the operator in their offer price should be taken into account. The example concerns a recent transfer of an operator under competitive tendering, where the incoming operator had prepared a new roster for drivers which reduced overtime and therefore take home pay, and which had been factored into a lower bid price. When the new operator advised the drivers of the lower pay, many of whom were employed previously by the losing incumbent, the drivers went on strike. There was a period of no services and significant reputational damage to the new operator. This was also made worse by a planned change in the timetable on some routes. This was not a good outcome for the government since customers complained. These are examples of disruption costs in bus contract transitions, more generally called transition costs.

The winner of a competitive tender may not be the operator whose offer price plus these additional transition costs (in its broadest interpretation) is the lowest, even if their offer price is the lowest in the tender process. Given the dominant role that the lowest offer price typically plays in the evaluation of competitive tenders and negotiated offers, even taking into account other key performance indicators[2] may result in a change in operator leading to greater total costs. This situation has not been investigated adequately[3] to see if transition costs, as perceived or anticipated potential costs are appropriately taken into account by members of the tender evaluation committee. Thus the focus of this paper is on the role, in competitive tendering or negotiation of a bus contract, of the potential disruption risk associated with contract transition and the role this plays in offer evaluation, as defined as an additional cost associated with a transition to a new operator.

[1] An example in another context is that when comparing private sector bids to the public sector comparator, it is important to ensure that the cost savings from using a public-private partnership arrangement is not outweighed by the transition and oversight costs (European Investment Bank, 2005).
[2] KPIs in some assessments are given a percentage allocation to be used in assessment of bids, but this does not necessarily ensure compliance.
[3] Wallis *et al.* (2010) did discuss this and suggested a mark up cost.

To examine these important questions, we develop a stated choice experiment in which we present tender evaluation committee members with a series of alternative operator bids that include, *ex ante*, a measure of the transition costs identified as a proportion of the lowest offer for the contract (noting that this is zero if the incumbent secures the contract) and two proxy descriptors of operator reputation (i.e., years in the bus business and success rate in winning contracts). The magnitude of the actual mark up (often referred to as a transaction or transition cost) is typically unknown (except possibly by the regulator and/or the incoming operator). Our focus here is on the mark up incurred beyond the costs to an operator[4] and includes the potential disruption to services associated with labour strikes[5], revised timetables, delays in securing new vehicles, and the additional administration costs to government associated with moving to a new provider.[6] These costs are rarely certain, except in the case of the incumbent securing the contract, and hence these enter the choice experiment probabilistically, which in turn offers information on the attitude to risk of the evaluators.

The analysis uses a mixed logit model (see Hensher *et al.* 2015) that accounts for preference heterogeneity in respect of evaluation of offers of the sample of individuals who have participated in the evaluation of bids under competitive tendering in a number of countries. This enables identification of the role that operator reputation and the offer mark up plays in addition to the offer price in the ranking of operators to establish the preferred provider. These additional influences can be described as embedded components of the transaction costs imposed on the regulator and society more generally when there is a contract transition. The mixed logit preference model permits the quantification of the implicit value attached to these additional elements, expressed as an aggregated measure of the value (in utility terms) of the contract offer.

The paper is organised as follows. The next section sets out how to identify the role of transition costs in influencing the preferences of tender evaluation committee members (even if these preferences are typically included in a subconscious manner). We then present the mixed logit model, as the choice setting in which to identify the role of such transition costs and other potential factors that impact on the evaluators rankings of operator offers. The survey is then presented together with details of how the choice experiment is designed. The collected data from a small sample of actual tender evaluation committee members is then summarised, followed by the estimated choice model results and the interpretation of the evidence. We conclude with the major findings and the importance of this paper in identifying, for the first time, the role that disruption costs in bus contract transitions play, consciously or otherwise, in the preferences of assessors.

[4] The incoming operator is also likely to incur transition costs but one might reasonably expect experienced operators to factor this into their offer price. If they do not then it adds to the risk of the winner's curse.
[5] As witnessed when there was a transfer of operators in Sydney in September 2013.
[6] The survey also included another experiment which we are not focussing on in this paper. This choice experiment presented a series of alternative sets of criteria that are the basis of evaluating tendered or negotiated offers, defined on a range of commonly used KPIs plus additional variables describing the reputation of the bidder in terms of recent success in winning contracts and years in the bus business. Respondents were asked to rank the criteria sets and to advise which ones are acceptable sets in assessing offers. This experiment helps us in identifying the role that cost efficiency (which is essentially the offer price) plays relative to other KPIs, including the reputation of an operator.

2. Accounting for Reputational Risk in the Assessment of Contracting Offers

It is often suggested that competitive bidding incurs higher levels of transactions costs than negotiated contracts, especially where the latter is initially with an incumbent operator. The logic goes along the following lines: negotiation with an incumbent operator who is well known to the regulator through an existing contract in the exact jurisdiction under renewal[7] provides lower transaction costs in that there is more common knowledge (be it positive or negative), enabling a greater focus on the delivery of future services without the necessary background checks and relationship building (in the sense of a trusted partnership) as well as risks associated with disruptions associated with changes in service inputs such as labour and capital.

It takes time to build such relationships, although the principal and agent must unambiguously be at 'arms length' under a commercial agreement. Nevertheless an underlying degree of trust is a necessary and constructive element of such relationships, be it obtained through negotiation or competitive tendering. While there will always be the risk of regulatory capture, a transparent process in which KPI expectations are clearly publicised should assist in minimising (if not eliminating) such concerns.

If transactions costs beyond those experienced by the operator play a significant role in the evaluation process, and by implication are costs that are not factored into the comparison of offer prices (no matter what process is in place), then strictly they are a cost attached to a contract, and should be added to the final price as an additional component of the value for money statement. Identifying such costs is challenging, but it is reasonable to assume that they are related to the reputation of the bidder or negotiator, and can be measured by proxy variables such as years of experience in the industry and the record of contract winning and renewal.

Identifying the contribution that these proxy variables play in offer assessment will not only establish their relevance, but also suggest some mark up, as defined relative to the influence of other KPIs that are explicitly defined and used in the assessment process. This provides one way of establishing the contribution of such variables as proxies for transactions costs on a preference scale that can be converted to a dollar value in the sense of their relative influence on value assessment associated with competing bids.

Consider a regulator who wishes to procure a bus service, be it a renewal through tendering or negotiation. If the service is provided according to the regulator's needs, the regulator will obtain a value of v^*. For a service to be designed and delivered, the regulator must provide the operator with a specification that describes the delivered service. In assessing the offer bids, the specification is laid out and a number of KPIs are used to assess each of the offers. Formally, we might define a set of explicit or observed KPIs that each member of the offer evaluation team considers in choosing the preferred operator. It is also likely that there exists an element of ambiguity in the set of KPIs as understood by each member of the evaluation team. Furthermore, there may be other considerations that influence the

[7] There may be many circumstances where an operator submitted a tender bid is not the incumbent but is well known and trusted by the jurisdiction assessing bids, because of their dealing in other locations; and thus it does not follow that the incumbent will necessarily have a strategic advantage in respect of perceptions about transitioning to the next contract.

offer outcome which are not explicit in the defined set of KPIs. We might refer to these as soft variables which condition each evaluator's position on each offer, and may include the perceived reputation of the offering bus business as defined by many possible factors including the success rate in the past in winning contracts and the reputation in delivering on all KPIs without default.

Formally, we can define the preference function associated with each evaluator as Equation (1), where each explicit KPI has a weight attached to it that indicates the role it plays in how an assessor trades amongst the set of KPIs in ranking the offers (including cut offs defining eligible and non-eligible offers). It is likely that each evaluator will have a position in respect of the degree of risk associated with each offer as based on other implicit (or subconscious) influences.

$$U_{on} = OSC_{on} + \sum_{kpi=1}^{KPI} \beta_{onkpi} X_{okpi} + \sum_{sv=1}^{SV} \gamma_{onsv} Z_{osv} + \varepsilon_{on} \quad (1)$$

U_{on} is the overall level of utility that the n^{th} evaluator attaches to the o^{th} offer, X_{okpi} is the set of well documented and essentially prescriptive KPIs whose influence in the evaluation process is represented by the parameters β_{onkpi}, which define the marginal utility contribution of each KPI to overall evaluator utility assigned to a specific bid offer. OSC_{on} is the offer-specific constant associated with the role, on average, of the set of unobserved influences associated with the n^{th} evaluator's preference for the o^{th} offer. In addition, there are the less well defined potential influences which we have defined by three proxy variables within Z_{osv} (i.e., years in the bus business, success rate in winning contracts, and non-operator transition costs), each associated with their own marginal utility metric γ_{onsv}. There will also exist other unobserved influences that potentially influence each evaluator's assessment preferences, and which are accommodated within ε_{on}, assumed to be distributed randomly across the operator bids and evaluators.

The changeover cost is a mark up on the lowest offer price. This variable, unlike the other more factual attributes, has an element of risk attached to it and is best treated as a range of possible mark-ups, each associated with a probability of occurrence. This form of presentation is aligned with the literature on perceptual conditioning and risk attitude, associated initially with the prospect theory (see Kanemann and Tversky 1979, and a review by Li and Hensher 2011).

3. The Mixed Logit Model

Under random utility maximisation (RUM), evaluators are assumed to impose preferences that support the offer which maximises utility. The mixed logit model is well documented in many sources (e.g., Hensher *et al.* 2015) and herein we provide a summary of the main elements. The central equation for the choice probability is:

$$\text{Prob[choice o by assessor } n \text{ in tender assessment choice situation } t \text{]} = \frac{\exp(\mathbf{x}'_{nt,o}\boldsymbol{\beta}_n)}{\sum_{o=1}^{O_n}\exp(\mathbf{x}'_{nt,o}\boldsymbol{\beta}_n)} = P_{nt}|_{\mathbf{v}} \quad (2)$$

The K model parameters are continuously distributed across individuals with

$$\boldsymbol{\beta}_n = \boldsymbol{\beta} + \boldsymbol{\Delta}\mathbf{z}_n + \boldsymbol{\Gamma}\mathbf{v}_n \quad (3)$$

where $\mathbf{z}_n$ may be a vector of individual characteristics that affect the mean of the random parameter distribution and $\boldsymbol{\Delta}$ is the associated parameter matrix. The underlying random effect, $\mathbf{v}_n$ is characterised by

$$E[\mathbf{v}_n] = \mathbf{0}, \text{Var}[\mathbf{v}_n] = \boldsymbol{\Sigma} = \text{diag}[\sigma_1,\ldots,\sigma_K] \quad (4)$$

where σ_k is a *known* constant. The variances and covariances of the joint distribution of $\boldsymbol{\beta}_n$ are parameterised in the unknown lower triangular matrix $\boldsymbol{\Gamma}$ which is to be estimated. The variance of the distribution of the parameters is

$$\boldsymbol{\Omega} = \boldsymbol{\Gamma}\boldsymbol{\Sigma}\boldsymbol{\Gamma}' \quad (5)$$

T_n observations are made on each evaluator (i.e., choice tasks). The conditional contribution to the likelihood is

$$\mathrm{P_n}|\mathrm{v_n} = \prod_{t=1}^{T_n} P_{nt} \mid \mathbf{v}_n \quad (6)$$

In order to form the unconditional likelihood, it is necessary to integrate $\mathbf{v}_n$ out of the joint probability. Thus,

$$P_n = \int_{\mathbf{v}_n} P_n \mid \mathbf{v}_n h(\mathbf{v}_n) d\mathbf{v}_n \quad (7)$$

where $h(\mathbf{v}_n)$ is the density of the standardised random vector $\mathbf{v}_n$. The likelihood expression can be enumerated through maximising the simulated log likelihood function:

$$\ln L_s = \sum_{n=1}^{N} \ln\left[\frac{1}{R}\sum_{r=1}^{R} \ln P_n \mid \mathbf{v}_{nr}\right] \quad (8)$$

where $\mathbf{v}_{nr}$ is a simulated random draw from the assumed distribution.

4. Development of the Sample and the Survey Instrument

The central feature of the survey instrument is a choice experiment, complemented by background questions (See Appendix A) on the experience of each respondent in the assessment of competitively tendered and/or negotiated bus contracts.

A stated choice experiment is developed in which the combinations of levels of each selected attribute are systematically varied to define a number of operator offers (see Hensher *et al*. 2015). Four attributes have been selected to describe the bidders, with the attributes and the levels to be assessed shown in

Table 1, and an illustrative choice scenario in Figure 1. In designing a choice experiment, the task is to find combinations of levels of the attributes that provide the best statistical outcome in respect of the efficiency of the design given the number of choice sets obtained, that will be blocked and assigned to each assessor such that the number of choice scenarios is a manageable number. We have chosen the *D*-efficient design which aims to minimise all (co)variances of all parameter estimates. In order to generate the *D*-efficient designs, it is necessary to assume prior parameter estimates. If these cannot be obtained from a pilot survey and are not known from other sources, as is the case herein, one can impose at least a sign condition, for example, the higher bid offer is likely to engender a negative parameter estimate. Ngene (Choice Metrics 2012) is used to generate the choice experiment design. The efficient design generated 20 choice scenarios which were blocked into four sets of five scenarios, and each operator was assigned one of the four blocks to review and respond to.

Table 1: The attributes and levels defining the choice experiment

Description of operator (attribute)	**Attribute level**
Incumbent (current holder of contract)	Yes, No
Offer price (LOP = Lowest Offer Price)	LOP, LOP + 10%, LOP + 15%, LOP + 20%
Years operator has been in the business	5, 10, 15, 30 years
Operator success rate in winning contracts (%)	5%, 30%, 50%, 80%
Changeover cost as % mark up on LOP	0%, 1%, 5%, 15%, 20%, 25%
Chance of changeover cost occurring	10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%

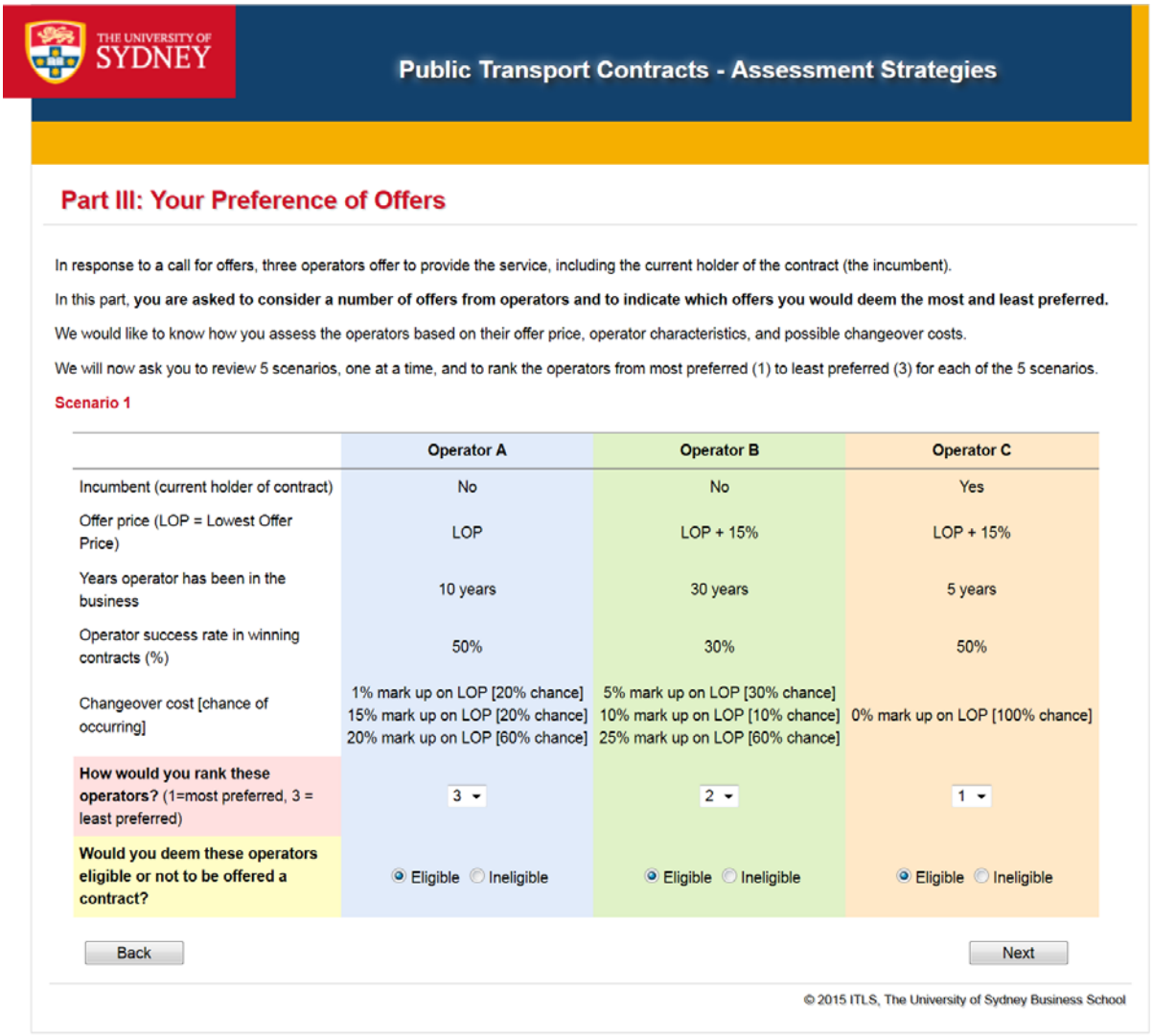


Figure 1: An illustrative choice screen

To enable us to implement the survey in many jurisdictions, with regulators around the world being invited to provide their views on the assessment strategies, we define each attribute and its levels in such a way that it was meaningful to all settings. The offer price would not make any sense in currency terms, and is best expressed as percentage variations from the lowest offer price (LOP), noting that the LOP can be assigned through the experimental design to any of the three operators labelled as Operators A, B, and C. The two selected operator reputational attributes are both easy to understand in any setting, and are the number of years that an operator has been in the bus business and the operator's success rate in winning contracts. We left this open to the respondents to interpret in respect of the number of years, in order to avoid the risk of limiting the response to a period in which the success rate may be high or low relative to some broad average. The fourth attribute, of special interest, is the estimated changeover cost as a percentage mark-up on the lowest offer price. These costs are defined as additional to any costs incurred by an operator, in where the latter are assumed to be factored into the operator's offer price. Given the uncertainty of the mark up, changeover costs associated with non-incumbent operators are defined in terms of the distribution with three levels, each having a probability of occurrence.

Three responses were sought from each evaluator when considering the three operator's bids in a choice scenario. We first requested a ranking of all three operators with 1 indicating the most preferred offer, and 3 the least preferred offer. This was followed by a question to establish which offers an evaluator deemed eligible (i.e., it would be in a final considered set as meeting the necessary compliance conditions). In recognition that not all attributes may have been attended to in assessment, we also sought advice on the reasons why an operator is deemed ineligible to the evaluator with one possible reason being the irrelevance of an attribute to the evaluator.

Given the nature of the study, it was essential that the respondents were members of a tender/negotiation evaluation team in the past or currently. Sourcing participants involved contacting key individuals in various countries who were known to us[8] and who were able to advise on eligible participants. Most importantly they also agreed to encourage the persons they put forward to participate in the survey.

The survey was designed as an online instrument. Each respondent was invited to participate via e-mail with a full explanation of the aims of the study and reference to a person who had suggested their participation. We identified 64 assessors from nine countries (Australia, New Zealand, UK, Chile, Singapore, Sweden, Malta, Switzerland and South Africa). The survey commenced in February 2015 and continued up to May 2015, after a pilot check on the instrument. Securing completed surveys from evaluators was challenging, with repeated reminders and a number of one-on-one phone calls and email meetings to explain the survey. A number of potential participants struggled to see how to contribute since they attempted to link the choice scenarios to their past experience instead of responding to the request to evaluate the circumstance as if this was the information in front of them in the future. After repeated follow ups, we closed the survey at 17 effective responses (a response rate of 26.5%), but one was dropped in the analysis due to concerns over the response. The 16 responses (3 from Australia, 4 from Switzerland, 6 from Chile, 2 from New Zealand and 1 from Singapore) on five choice scenarios provided 80 observations (associated with three alternatives) for choice model estimation. This is sufficient data to obtain interesting (albeit preliminary) evidence[9].

5. Descriptive Profile of sample

Table 2 provides a profile of the sampled evaluators. On average, in the last ten years an evaluator was involved in 8.5 evaluations, or slightly less than one evaluation per year. Most of the evaluations involved competitive tendering which reflects the increasing numbers of jurisdictions moving to competitive tendering for their land based public transport. The evaluators identified that about 3.0 out of 8.5 evaluations over the last ten years had been negotiated contracts with most of these being with the incumbents. On average, evaluation committees consist of 5.6 members with the majority of members (13 out of 16 respondents) believing they had equal voting rights when it came to selecting the preferred operator. On average, each evaluation committee used six selection criteria to assess the bidders/negotiators and 44 percent of the assessors (7 committee members) said that operator reputation played a role in the evaluation process. When asked to reveal an indicator for operator reputation, most assessors listed 'experience in operating public transport services' as the most important, followed by proven track record and the ability to demonstrate innovation and cooperation with the government in

[8] We are especially indebted to Ian Wallis, Tim Arbuckle, Juan Carlos Munoz and Waiyan Leong.
[9] While the variability in data over 80 observations applies for the design attributes, the other data varies only across the 17 observatioins, and this has limited the potential role that such data items might play.

order to improve services. Financial strength and fleet size were also mentioned as a proxy for the operator reputation but by only one evaluator. The results support the use of years in business as a proxy for measuring operator reputation in the stated choice experiment as a way to help evaluation committees estimate changeover costs associated with new operators, if this is to be added to the offer price for comparison.

Table 2 Profile of the assessors and the nature of the assessments

	Mean/Median
Total number of assessments involved in last 10 years	8.5*
Number of negotiated assessments involved in last 10 years	3.0*
Negotiated assessment with incumbents	2.5*
Minimum number of operators entered in the assessment process	2.1
Maximum number of operators entered in the assessment process	7.8
Number of committee members	5.6
Committee members have equal voting rights	81%
Rules to permit politicians to override the committee's suggestion	25%
Number of assessment criteria (KPIs)	6.2
Operator reputation plays a role in assessment	44%

* *indicates median value.*

In terms of selection criteria, it is interesting to see a consistent set of KPIs considered by evaluators across different jurisdictions. Out of an average set of six selection criteria reported to be actually used in the evaluation process (Table 2), Table 3 shows that service reliability and cost efficiency were deemed as relevant by all evaluators. Also important are operator indicators of customer service, safety and asset conditions. A proxy for operator reputation – number of years in the business – is considered equal rank in importance as patronage growth, while other KPIs such as information, provision of assets if incumbent is not provided, and social welfare are slightly less important. Of the 11 KPIs listed for evaluators to rank, operator success rate in winning contracts is the least important with only a quarter of assessors (4 out of 16) identifying it as important enough to be considered as a selection criterion in the evaluation process. It is also worth a mention that the ranking of KPIs in Table 3 is largely consistent with that in real world assessment processes. That is, service reliability was used as a selection criterion by 75% of the committees in their last assessment, with the numbers for cost efficiency, customer service, safety and asset conditions being 94%, 50%, 44%, and 50% respectively. Patronage growth and years in business were used by 38% of the committees in their last evaluations while information provision was used by 19% of the evaluation committees, social welfare aspects and asset provision 13%, and operator success rate in winning contracts only 6%.

Table 3 KPIs that regulators think should be in the assessment process and their rank

Key Performance Indicator (KPI)*	No. assessors deemed relevant	Average rank	Highest rank	Lowest Rank
Service reliability (rate of on-time services; cancelled/incomplete services, punctual headways)	16	2.0	1	4
Financial (cost efficiency measured by $/km service or $/hour service)	16	2.7	1	7
Customer services (Complaints per boarding; complaint resolution; customer satisfaction; etc.)	14	2.9	1	10
Safety (number of major defects; preventable accidents; major incidents)	14	3.8	1	9
Asset condition (depots, vehicle fleet, fleet age, other critical systems)	14	4.8	1	8
Patronage (growth in passenger km per annum; passenger crowding; revenue collection rate)	9	4.8	1	8
Years operator has been in the business	9	5.3	1	10
Information (for regulator, passengers and third party)	8	5.8	3	8
Social welfare (social inclusion including affordability; accessibility for users)	8	7.6	2	11
Ability to provide assets if incumbent will not hand over	8	7.6	2	10
Operator success rate in winning contracts	4	9.3	4	11

** See Appendix A for a detailed description of each KPI.*

6. Key Findings

A series of mixed logit models were estimated, in which we investigated the role of each of the attributes in the choice experiment. The changeover cost was transformed to a probability weighted cost, and together with the other attributes included with both random and non-random taste weight in order to establish the extent of preference heterogeneity. We considered a number of distributional assumptions for the random parameters, particularly unconstrained and constrained normal and triangular distributions. The best statistical fit was with the constrained triangular distribution[10] which specifies that the mean of the distribution is a free parameter, β, but the two endpoints of the distribution are fixed at zero and 2β, so there is no free variance (scaling) parameter. The parameter will satisfy a single sign, which is behaviourally appealing when the sign is expected to be either positive or negative as in the offer price and the changeover cost, both hypothesised to have a negative sign. Other attributes such as operator success rate could go either way; however the analysis herein suggested that a constrained triangular was the only distribution that obtained a statistically significant standard deviation parameter estimate (possibly dues to the relatively small sample size and hence limits of preference heterogeneity), which is shown in the results to be negative.

[10] Let c be the centre and s the spread. The density starts at c-s, rises linearly to c, and then drops linearly to c+s. It is zero below c-s and above c+s. The mean and mode are c. The standard deviation is the spread divided by $\sqrt{6}$; hence the spread is the standard deviation times $\sqrt{6}$. The height of the tent at c is 1/s (such that each side of the tent has area s×(1/s)×(1/2)=1/2, and both sides have area 1/2+1/2=1, as required for a density). The slope is $1/s^2$.

The final model is summarised in Table 3. We accounted for the correlation between respondent's choices across five scenarios that each evaluator was asked to review and rank. We also considered scaled multinomial logit and latent class models but they were not an improvement over the standard random parameters model form.[11] The alternatives are unlabelled and hence an offer-specific constant (OSC_{on}) is not included. The overall goodness of fit is very good with a pseudo R^2 of 0.409. We were unable to identify any statistically significant influences beyond those investigated in the stated choice experiment. We believe that this is due to the small sample size of 17 assessors, and as we increase the sample size in ongoing research, we can test for the role of other KPIs.

Table 3: Preferred Mixed Logit Model

16 assessors, 80 observations, 200 Halton draws

Attribute	Parameter estimate	t-ratio
Mean of random parameters		
Offer price as % mark up on lowest offer price (LOP)	-0.1474	-4.79
Operator success rate in winning contracts (%)	-0.0130	-2.06
Weighted changeover cost as % mark up on LOP*	-0.0948	-3.71
Standard deviation of random parameters		
Offer price as % mark up on LOP	-0.1474	-4.79
Operator success rate in winning contracts (%)	-0.0130	-2.06
Weighted changeover cost as % mark up on LOP*	-0.0948	-3.71
Model summary statistics		
Log-likelihood at convergence	-51.88	
McFadden pseudo R^2	0.409	
Information criterion AIC/N	1.372	

* $Weighted\ changeover\ cost = \sum_{i=1}^{3} Prob_i\ x\ ChangeoverCost_i$

The negative sign for the offer price and the changeover cost mark up are expected; however the sign for the operator success rate in winning contracts is less clear and could have gone either way. One evaluator indicated that they are cautious of operators who promote prior success, and stated in the open-ended survey responses that "…a high success rate such as 80 percent indicates an irresponsible pricing policy and tends to drives poor service quality. In addition, these operators are typically aggressive bidders, and this often comes with higher associated changeover cost." It appears that this sentiment is translated throughout the majority of the evaluator set in the negative parameter estimate.

The main focus of the study is to establish the role that soft variables may play, and to see if the changeover cost has a role (subconsciously in most situations). What is interesting is the statistical non-significance of the number of years that an operator has been in the bus service business[12] and whether they are the incumbent or not. However, the changeover cost associated with transaction costs (or costs

[11] An error components mixed logit model makes no behavioural sense with unlabelled alternatives (although right to left bias could be accounted for if it is found to be present).
[12] Which may not be an appropriate representation of experience in operating public transport services which was suggested by assessors as of relevance.

of transition and possible disruption) is statistically very significant and reaffirms what we thought might be the case. The parameter estimates per se, however, have little meaning in comparing the influence of each significant attribute; what is of more behavioural interest is the construction of the marginal rate of substitution (MRS) between the offer price and the changeover cost. Given that the two attributes of interest are random parameters, there is a distribution of MRS to account for preference heterogeneity, as summarised in Figure 2.

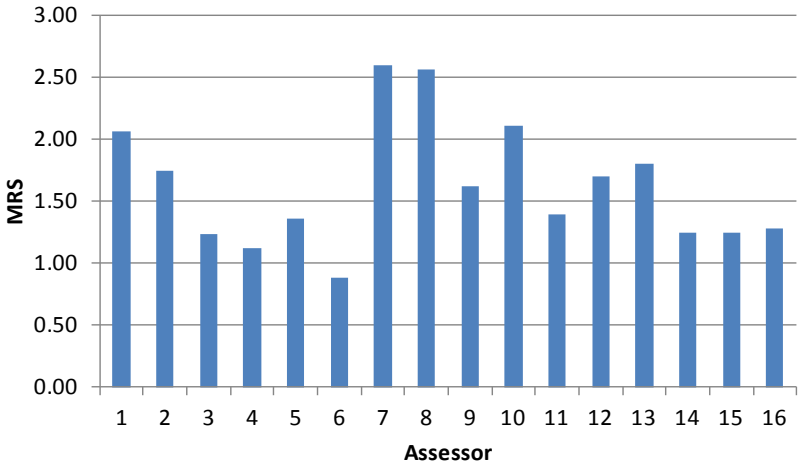


Figure 2: Marginal rate of substitution between offer price and changeover cost

The mean is 1.62 (a median of 1.51) with a standard deviation of 0.13 and a range from 0.88 to 2.60. Given the skewness of the data (i.e., a deviation from a normal distribution which explains the difference between the mean and the median), we will interpret the median as the best estimate of the relationship between the offer price and the risk aligned changeover cost. The estimate of 1.51 indicates that on average, a member of a competitive tender evaluation team values a 1% higher changeover cost (as a probability weighted estimate) as equivalent to a 1.51 percent higher offer price, *ceteris paribus*. This might be interpreted as a relative risk index. In other words, they would be indifferent between an additional 1.51 percent increase in the offer price and a one percent increase in the changeover cost, both measured as a percentage mark up on the lowest offered price. Another way of putting this is that, on average, a tender evaluation committee member is indifferent between two tenders where one has the lowest offer price but is one percent higher in the changeover cost than the incumbent tender which is 1.51 percent higher in the offer price.

In addition to the marginal rate of substitution reported above, the mean direct elasticities are also of interest. The direct elasticity of the probability of choosing an operator with respect to the offer price is -0.61, suggesting that the probability that an operator being selected will decrease by 0.61 percent if its offer price is one percent higher than the lowest offer price. The direct elasticity with respect to the changeover cost mark up is -0.89, and with respect to the success rate it is -0.33. These elasticities are interpreted in the same way as the offer price elasticity.

7. Conclusions and Implications

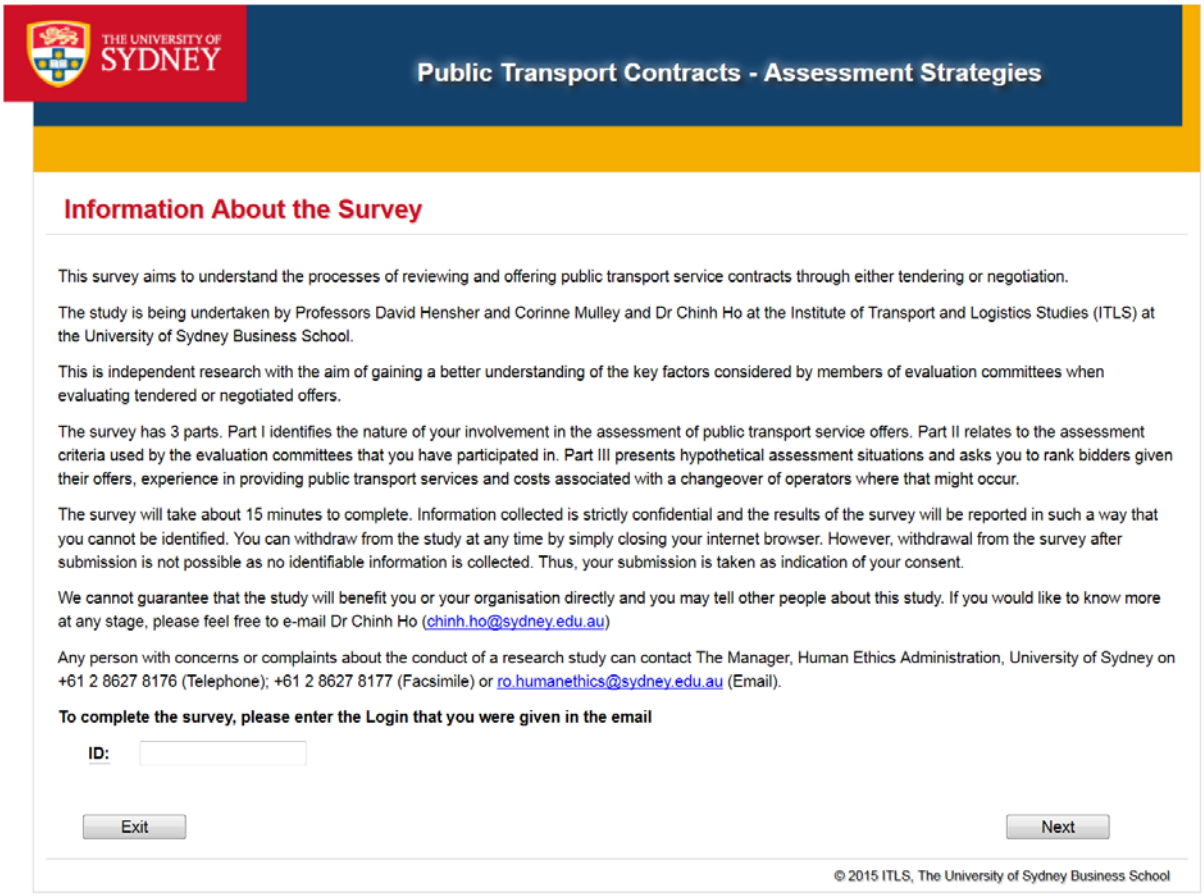
This paper provides evidence that evaluators on tender evaluation committees do recognise the inherent risks in changing the service provider in bus contracts, and that it is possible to quantify the financial trade-off that evaluators make in balancing the risk associated with transition and disruption and the offer price. For example, if we take the median marginal rate of substitution between changeover cost and offer price of 1.51, then the prices offered by a new provider might be adjusted upwards by the evaluation committee in their recognition of the impact of uncertainty due to expected risk of incurring transition costs from change of incumbent, with the adjusted amount depending on the lowest offer price. For example, if the lowest offer price was \$120m, with the offer price of the incumbent being \$135m, or 12.5 percent higher than the lowest price, then to be preferred as a new operator, the estimated changeover cost associated with the non-incumbent operator must be smaller than 12.5/1.51 = 8.3 percent of the lowest offer price (or equivalent to 8.3 percent ×\$120m = \$9.96m). Alternatively, if the tender with lowest offer price has an estimated cost of changeover equivalent to 10% of their offer price[13], their risk normalised offer price is \$120m + 10%×120×1.51 = \$138.1m, which is higher than the incumbent's price and therefore the incumbent is preferred. The extent to which the non-incumbent offer prices are adjusted will depend on the lowest offer price and the risk profiles of the evaluation committee.

In ongoing research, we are hoping to increase the number of participating evaluators and to condition the attributes associated with the choice scenarios with the contextual setting associated with country, other KPIs and evaluator experience. The current sample size does not offer enough variation in the data items outside of the choice experiments to be able to test for these other potential influences; however we anticipate that this will temper the current evidence but not nullify it. A further research task is to obtain *ex post* evidence of the magnitude (in absolute and relative terms) of the mark up required to account for the risk differential between an incumbent and a potential new entrant. This is likely to be jurisdiction specific, but will be necessary to identify a meaningful risk normalised offer price that is a true reflection of the lowest offer price (regardless of what other criteria are used in assessing offers)[14].

[13] We currently have no indication of the real world changeover cost mark up, and hence this is an illustrative example only.

[14] The recent competive tendering of bus services in Singapore (see Goh *et al.* 2015) selected the operator who was not the least expensive but the third least expensive, with service quality and other considerations such as training being taken into account in a multidimensional evaluation process using a the method of Analytical Hierarachical Processes. A gross cost model (with contracts between 5 and 7 years) was used with government providing bus infrastructure (depots and interchanges), buses, fleet management system and ticketing system

Appendix A Background Questions



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Public Transport Contracts - Assessment Strategies

Information About the Survey

This survey aims to understand the processes of reviewing and offering public transport service contracts through either tendering or negotiation.

The study is being undertaken by Professors David Hensher and Corinne Mulley and Dr Chinh Ho at the Institute of Transport and Logistics Studies (ITLS) at the University of Sydney Business School.

This is independent research with the aim of gaining a better understanding of the key factors considered by members of evaluation committees when evaluating tendered or negotiated offers.

The survey has 3 parts. Part I identifies the nature of your involvement in the assessment of public transport service offers. Part II relates to the assessment criteria used by the evaluation committees that you have participated in. Part III presents hypothetical assessment situations and asks you to rank bidders given their offers, experience in providing public transport services and costs associated with a changeover of operators where that might occur.

The survey will take about 15 minutes to complete. Information collected is strictly confidential and the results of the survey will be reported in such a way that you cannot be identified. You can withdraw from the study at any time by simply closing your internet browser. However, withdrawal from the survey after submission is not possible as no identifiable information is collected. Thus, your submission is taken as indication of your consent.

We cannot guarantee that the study will benefit you or your organisation directly and you may tell other people about this study. If you would like to know more at any stage, please feel free to e-mail Dr Chinh Ho (chinh.ho@sydney.edu.au)

Any person with concerns or complaints about the conduct of a research study can contact The Manager, Human Ethics Administration, University of Sydney on +61 2 8627 8176 (Telephone); +61 2 8627 8177 (Facsimile) or ro.humanethics@sydney.edu.au (Email).

To complete the survey, please enter the Login that you were given in the email

ID:

Exit Next

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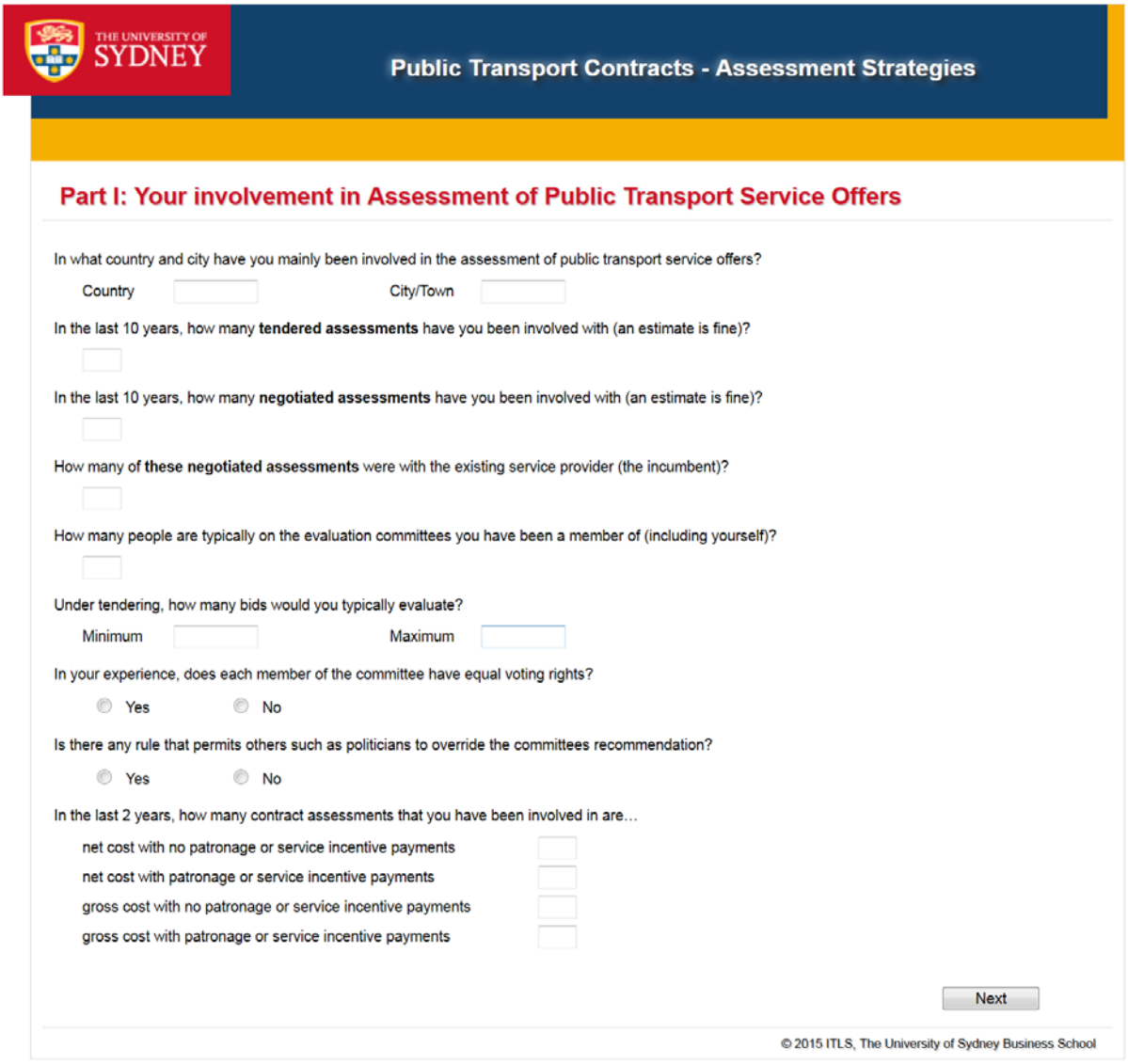
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Public Transport Contracts - Assessment Strategies
Part I: Your involvement in Assessment of Public Transport Service Offers
In what country and city have you mainly been involved in the assessment of public transport service offers?
Country
City/Town
In the last 10 years, how many tendered assessments have you been involved with (an estimate is fine)?
In the last 10 years, how many negotiated assessments have you been involved with (an estimate is fine)?
How many of these negotiated assessments were with the existing service provider (the incumbent)?
How many people are typically on the evaluation committees you have been a member of (including yourself)?
Under tendering, how many bids would you typically evaluate?
Minimum
Maximum
In your experience, does each member of the committee have equal voting rights?
Yes
No
Is there any rule that permits others such as politicians to override the committees recommendation?
Yes
No
In the last 2 years, how many contract assessments that you have been involved in are...
net cost with no patronage or service incentive payments
net cost with patronage or service incentive payments
gross cost with no patronage or service incentive payments
gross cost with patronage or service incentive payments
Next
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Public Transport Contracts - Assessment Strategies

Part II: Assessment Criteria

How many assessment criteria (or key performance indicators, KPIs) are typically used to assess PT service offers?

Does the reputation of a provider have a role in the assessment process?

Yes No

Which of the following 11 KPIs do you think should be in the assessment process (regardless of whether they have actually been used to date)?

Please rank your most preferred KPI as a '1' in the column, the next preferred as a '2' and so on. Leave the column empty for KPIs you feel are irrelevant.

KPI 1 Financial (cost efficiency measured by $/km service or $/hour service)	
KPI 2 Patronage (growth in passenger km per annum; passenger crowding; revenue collection rate)	
KPI 3 Service reliability (punctuality rate measured by on-time services; cancelled/incomplete services, punctual headways for non-timetabled frequent services)	
KPI 4 Customer services (Complaints per boarding; complaint resolution; response time; complaint/enquiries database; customer satisfaction; contract bus presentation)	
KPI 5 Safety (Incidents due to failure to conduct maintenance; number of major defects; preventable accidents; major incidents including security incidents)	
KPI 6 Information for regulator, passengers and third party	
KPI 7 Social welfare (social inclusion including affordability; accessibility for users)	
KPI 8 Asset condition (depots, vehicle fleet, fleet age, other critical systems)	
KPI 9 Ability to provide assets if incumbent will not hand over	
KPI 10 Years operator has been in the business	
KPI 11 Operator success rate in winning contracts	

In the most recent assessment you were involved with, which of the following 11 KPIs were actually used?

Tick those that were used.

KPI 1 Financial (cost efficiency measured by $/km service or $/hour service)	
KPI 2 Patronage (growth in passenger km per annum; passenger crowding; revenue collection rate)	
KPI 3 Service reliability (punctuality rate measured by on-time services; cancelled/incomplete services, punctual headways for non-timetabled frequent services)	
KPI 4 Customer services (Complaints per boarding; complaint resolution; response time; complaint/enquiries database; customer satisfaction; contract bus presentation)	
KPI 5 Safety (Incidents due to failure to conduct maintenance; number of major defects; preventable accidents; major incidents including security incidents)	
KPI 6 Information for regulator, passengers and third party	
KPI 7 Social welfare (social inclusion including affordability; accessibility for users)	
KPI 8 Asset condition (depots, vehicle fleet, fleet age, other critical systems)	
KPI 9 Ability to provide assets if incumbent will not hand over	
KPI 10 Years operator has been in the business	
KPI 11 Operator success rate in winning contracts	

Other than the 11 KPIs above, were there any other KPIs being used in your most recent assessment?

Yes No

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