DISCUSSION PAPER[1]

TENDER EVALUATION
VALIDITY OF QUANTITATIVE TECHNIQUES

Abstract

Computer-based tools are available as aids to the systematic evaluation, documentation and comparison of competing tenders and often employ quantitative techniques to determine 'value' indexes as quantified measures of the worth to the buyer of an offer. Thus, this paper explores the validity of quantitative indexes and their limitations in tender evaluation. It argues that value indexes and particularly value for money indexes are more limited in their power than given credit for by proponents. ***Key words****: tender evaluation; value indexes; quantified measures of value.*

Introduction

1. Whether in the defence or other domain, computer-based tools are used as aids to the systematic evaluation, documentation and comparison of competing tenders.
2. These tools often employ quantitative techniques to determine 'value' indexes as quantified measures of the worth to the buyer of an offer and to use the indexes for the direct, ratio comparison of offers. The process is sometimes taken further to calculate 'value for money' indexes, by the division of the value indexes by respective tendered prices, which may be used as an additional basis of comparison.
3. This paper contends that value indexes and particularly value for money indexes are more limited in their power than given credit for by proponents. Specifically, this paper contends that:
   - value indexes are capable only of ranking competing offers and do not permit the valid comparison of offers as ratios, ie value indexes can say that one offer is better than another, but cannot say how much better;
   - a value for money index is an undefined quantity, devoid of any real meaning and invalid for use in comparison of offers;
   - unless special precautions are taken, some evaluation models may not produce reliable results, in that rankings of offers may change depending on data values applied to model parameters; and
   - that value indexes and tendered prices should only be used as separate data inputs to qualitative (narrative) analysis and comparison of offers.
4. Thus, this paper explores the validity of quantitative indexes and their limitations in tender evaluation.
5. This paper does not challenge the benefits of these models in the systematic evaluation and documentation of offers, which can be a daunting task in its own right, nor discuss other aspects necessary to complete and useful evaluation models.

Definitions

6. Most if not all capitalised terms used herein are defined at **Annex C**.
7. Definitions are provided for the purposes of this discussion and do not purport to be universally accepted. However, they are meant to be accurate.

Quantitative Evaluation Process

8. As a basis of discussion, it is considered necessary to describe the quantitative process that underpins most if not all evaluation models using quantitative techniques. The process, which is described below, is illustrated by and may be followed in the sample spreadsheet at **Annex B**.

9. Individual models will differ in detail and terminology but the basic process used during preparation of the Request for Tender and applied during evaluation, will comprise several essential and common steps.
10. Certain steps are taken during preparation and before issue of the RFT:

[1] Disclaimer: This paper does not assert nor imply in any way that the Australian Department of Defence or any other Australian government department or agency has ever or is conducting tender evaluation in an improper manner.

- Decide what will constitute the Supplies under the proposed contract. These should include at least the technical system, the support system, the delivery system and the commercial system (Australian Industry Involvement, financial performance and compliance with organisational policies).
- Prepare the Statements of Work for each category of Supplies.
- Prepare the technical requirement specification for the technical system, in a fully indentured form.
- Define the Relative Importance Designators that will apply (document in the tender evaluation plan), eg Essential, Highly Desirable, Desirable and Information Only.
- Decide the Relative Weight to be assigned to the defined Relative Importance Designators (document in the tender evaluation plan).
- Tag each specification (requirement), for the technical system, at lowest level of indenture with a Relative Importance Designator.
- Tag each level of indenture, ie for sub-systems and sub-sub-systems, with a Relative Importance Designator.
- Determine the Normalised Relative Weight of each set of specifications at the lowest level of indenture and for each level of indenture within each branch.
- Define the Levels of Compliance that will apply (document in the tender evaluation plan).
- Decide Relative Compliance Values to apply to the defined Levels of Compliance (document in the tender evaluation plan).

11. Subsequent steps are taken during evaluation of each competing tender:

- Assess the Effectiveness of the offer against each specification, at the lowest level of indenture, in each branch of the requirements tree.
- Decide the Level of Compliance for assessed Effectiveness.
- Address all non-compliances against Essential requirements.
- Assign a value index for assessed Effectiveness, using one of the pre-set Relative Compliance Values, or adjusted as appropriate. In particular, the Relative Compliance Value for offers excess to requirement may need to be adjusted.
- Determine Weighted Values of the offer against each specification (adjusted Relative Compliance Value * Normalised Relative Weight of the respective specification).
- Assign and apply a risk factor to each Weighted Value to obtain Risk Adjusted Weighted Values.
- Determine the Risk Adjusted Weighted Value index for each set of specifications at lowest level of indenture (Sum of Risk Adjusted Weighted Values in a set, divided by the Normalised Relative Weight of the respective set of specifications).
- Aggregate Risk Adjusted Weighted Value indexes up through the levels of indenture, applying the Normalised Relative Weight for each set of specifications at the same level of indenture, to obtain the Risk Adjusted Weighted Value index for the technical system as a whole (that subject of the technical requirement specification).
- Repeat the process to determine the aggregated Risk Adjusted Weighted Value indexes for each of the other supply categories - support system, delivery system and commercial system. Note that these systems may not require the tagging of requirements with Relative Importance Designators in the respective Statement of Work, except perhaps for requirements that are truly Essential and could cause set-aside of a tender if non-compliant.
- Determine the aggregated, weighted Risk Adjusted Weighted Value index for the Supplies as a whole, using the Relative Weights and Risk Adjusted Weighted Value index for each.
- Determine the respective cost for a tender. In the case of Supplies under a contract, this would be the tendered contract price. However, if acquisition and through life support contracts are being considered together, the Life Cycle Cost may be used, in which case, an aggregated, weighted Risk Adjusted Weighted Value index would be required for the two contracts combined.
- If required by the evaluation plan, divide the aggregated, weighted Risk Adjusted Weighted Value index by the respective proposed contract price (or LCC as applicable) to obtain a value for money index.

- Assume that the value for money indexes determined for each tender can be compared mathematically as ratios, ie that one is 'x' times larger (better) than another.
- If required by the evaluation plan, select the tender with the largest value for money index.

12. The preceding process may be set up on spreadsheets or in a database application, each complemented with additional features for error trapping and reporting, documentation of rationale and reporting of results.

13. However, certain aspects of the foregoing process are considered invalid. It is the purpose of this paper to show that:

- Risk Adjusted Weighted Value indexes, whether determined for each set of specifications at the lowest level of indenture or for aggregations at higher levels of indenture, are capable only of ranking competing offers and do not permit the valid comparison of offers as ratios;
- a value for money index is an undefined quantity, devoid of any real meaning and invalid for use in comparison of offers;
- rankings produced by Risk Adjusted Weighted Value indexes may not be consistent, ie some evaluation models may not produce reliable results, in that rankings of offers may change depending on values applied to model parameters; and
- as a consequence of invalidity of the quantitative process, comparisons of tenders should be made qualitatively and selection decisions made as a matter of judgement.

14. **Note:** Risk Adjusted Weighted Value indexes determined for offers against individual specifications can be in the Ratio Scale, within the limitations of the assumed Utility/Effectiveness relationship. This means that tender offers for an individual specification could be directly compared, ie how much better is one than another. However, once Weighted Value indexes for a set of specifications are combined, the result is in the Ordinal Scale (ranking only), unless all requirements in the set are in fact in the Ratio Scale. The latter situation is somewhat unlikely, therefore, the scale of the Weighted Value for a set of requirements will be Ordinal at best and capable only of ranking.

Scales of Measurement

15. The invalidity of assuming that value indexes can permit ratio mathematical operations (multiplication and division) is explained by reference to what researchers refer to as the 'scales of measurement'. Texts [2] on the subject define four scales of measurement and warn against their improper application in terms of statistical manipulation and amenity to mathematics.

16. The four scales, in order of complexity, are Nominal, Ordinal, Interval and Ratio. These are described in **Table A1, Annex A**.

Relative Importance Designator

17. Relative Importance Designators, eg Essential (E), Highly Desirable (HD), Desirable (D) and Information Only (IO), are required whether evaluation is done quantitatively or qualitatively.

Relative Weights

18. Relative Weights assigned to defined Relative Importance Designators comprise a major source of invalidity of value indexes.

19. In the first instance, how does one compare the relativity of an Essential requirement and others? Assuming a value of '1' for Essential and '0' for Information Only, what intermediate values does one assign for Highly Desirable and Desirable? Can one validly say that a Highly Desirable requirement is 'x' per cent as good as an Essential requirement? At best, Relative Weights will be in order of importance, ie in the Ordinal Scale.

Relative Compliance Values

20. A similar argument applies to the set of Relative Compliance Values struck for the defined Levels of Compliance, in that the this set of values would not necessarily be appropriate for evaluation of the Effectiveness of offers against all specifications. However, the assignment of a Raw Value to an assessed Effectiveness is easily made a matter of judgement by the analyst, within the limitations of striking a Utility/Effectiveness relationship (see later discussion on Utility).

[2] Research Concepts in Human Behaviour, C.C. Helmstadter, Prentice and Hall 1970

21. Notwithstanding the foregoing, the Weighted Values are obtained by multiplying the Raw Value by the respective Normalised Relative Weight. As the latter is in the Ordinal Scale, so will Weighted Values be in the Ordinal Scale. Aggregated indexes, right up to the Supplies themselves, will also be in the Ordinal Scale. Once values in the Ordinal Scale are involved, the scale of indexes, whether individual or aggregated, cannot be improved. Thus, the Ratio Scale cannot apply to aggregated indexes and any assumption that they are in the Ratio Scale, ie will permit ratio mathematical operations (multiplication and division), is invalid.

Risk

22. While one can properly define a set of Risk categories, the range of relative values assigned to these categories will be in the Ordinal Scale, ie relative values would reflect ranking only.

Utility

23. Utility is the perceived worth to the buyer of assessed Effectiveness of an offer. It is an important concept that is explored in more detail at **Annex A**.

Consequences of This Invalidity

24. If the use of value for money indexes to compare competing tenders is invalid as contended, one could well ask what the consequences of the practice might be. The worst of these would be to recommend or select the wrong tender, ie one offering less value for money than at least one other. This would be bad for both the buyer and the losing tenderer. It could be even worse for the buyer if the losing tenderer decides to sue the buyer for a flawed selection process.

25. Selection of the lesser option could occur for two basic reasons:

- value for money indexes are produce only rankings of offers, not valid ratios of value; and
- an unreliable model may produce an incorrect ranking of offers.

26. To illustrate the first point, the example at **Table 1** shows how things can go wrong.

Table 1
Example of Selection Error

Tender	Calculated Value Index (ranking)	Cost	Calculated Value for Money Index (non-defined quantity)	Assessed Value Index (evaluated Qualitatively)	Assessed Value for Money Index (non-defined quantity)
A	1.00	1.00	1.00	1.00	1.00
B	1.10	1.30	0.85	1.50	1.15
			Tender A chosen		**Tender B chosen**

27. A related consequence is that project directors/managers and selection committees could be tempted to take the easy way out in tender selection by relying on use of the value for money indexes, when more difficult qualitative analysis and judgement is called for. This tendency would be far more likely to occur with small value tenders.

Non-Compliance of Essential Requirements

28. Non-compliances against Essential requirements cannot be treated in the same way as non-compliances against non-Essential requirements and should be treated and resolved before further evaluation takes place. See **Annex A** for a recommended process for handling such non-compliances.

Sensitivity Testing

29. Depending on values assigned to certain model parameters during preparation of the tender evaluation plan, an evaluation model may not be able to produce the same ranking for a given set of competing offers, ie the model may not be robust enough to handle the possible ranges of model parameter data.

30. The robustness of evaluation models should be verified by sensitivity testing of the following model parameters (or equivalents), for a standard set of data for say a sample of three competing tenders (or better still, live tender data):

- Relative Weight of Specification assigned according to Relative Importance Designators;
- Raw Values assigned to Levels of Compliance; and
- Risk values assigned to defined categories of Risk.

31. It can be shown that the values used for Relative Weights of Specification are capable of changing the ranking of aggregated value indexes. Thus, Relative Weights of Specification should always be subject to sensitivity testing to verify the stability of rankings and how they may change. Rankings appear to be significantly sensitive to values adopted for Relative Weights of Specification.
32. Sensitivity testing would most likely show that rankings are not very sensitive to Raw Values assigned to Levels of Compliance.
33. Sensitivity testing would most likely show that rankings are not significantly sensitive to values assigned to Risk categories.

Acid Tests

34. Can one believe that any set of Relative Weights of Specification defined for respective Relative Importance Designators is in the Ratio Scale, ie show that one requirement is 'x' times more important than another?
35. Given the arguments outlined in this paper, can one believe that any of the Aggregate Risk Adjusted Weighted Value indexes, up through the levels of indenture, is in the Ratio Scale, ie show that one tender offer is 'x' times better (more valuable) than another?
36. To both questions:
    - if the answer is 'yes', it behoves the reader to justify that belief, at least to oneself but also to others;
    - if the answer is 'no', one has to presume that values indexes are in the Ordinal Scale, capable only of ranking and, as a corollary, accept that any value for money index calculated is a non-defined value, meaningless and invalid.

Conclusions

37. This paper has provided a rational argument, based on the relevance of the four Scales of Measurement, to expose the invalidity of assuming that value indexes are capable of any more than the ranking of options.
38. Given that aggregated values indexes are capable only of ranking, any value for money index calculated on this basis is a non-defined value, meaningless and invalid.
39. The determination of value indexes to obtain rankings is a bona fide practice provided that the model can be shown (through sensitivity testing) to reliably produce the same ranking of a given set of offers, irrespective of the values that may be assigned to model parameters.
40. As a consequence of invalidity of the quantitative process, value indexes and tendered prices should only be used as separate data inputs to qualitative analysis and comparison of tenders. Selection decisions should be a matter of judgement.

M.R. Flint [3]
Australian Logistics Study Centre

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[3] Mr Flint is a private consultant with many years' experience as a maintenance engineer and logistician in the RAAF, some seven years as a director in Defence concerned with policy for Defence-related industry and six years as a director in Defence of capital equipment acquisitions. Over the past six years or so he has worked with major suppliers in preparation of responses to Australian Department of Defence Requests for Tender; and with project offices within the Australian DOD.

ANNEX A TO
EVAL_QUANT_10JAN22

ADDITIONAL ARGUMENT

Scales of Measurement

1. The invalidity of assuming that value indexes can permit ratio mathematical operations (multiplication and division) is explained by reference to what researchers refer to as the 'scales of measurement'. Texts [4] on the subject define four scales of measurement and warn against their improper application in terms of statistical manipulation and amenity to mathematics.
2. The four scales, in order of complexity, are Nominal, Ordinal, Interval and Ratio. These are described in **Table A1**.
3. In a Request for Tender, in particular in Statements of Work and technical specifications, requirements are many and varied, through several and often many levels of indenture. Ideally, requirements are specified not only by function but also with associated criteria for performance (quality) in terms of variables and attributes, units of measurement and value ranges.
4. The respective units of measurement and value ranges for each of these requirements will be in one of the four scales of measurement and all scales will be represented. Also, mixtures of scales may occur within requirements at the same lowest level of indenture in any branch of the requirements tree. Thus, the value of tender offers for requirements with different scales are being evaluated at different indenture levels, in multiple branches and rolled-up to the highest level of indenture.
5. As to why the use of value for money indexes can be invalid, the central thesis of this paper is that value indexes assigned to offers against the many specified requirements, which range across the four scales of measurement, cannot produce a rolled-up value index that is better than the Ordinal scale, ie one capable only of ranking entities. Given that this thesis is in fact true, any value for money indexes produced from the use of a rolled-up value index will be a non-defined quantity and their use to compare competing entities quite invalid.

Table A1
Scales of Measurement

Scale	Description	Examples
Nominal	The Nominal scale can determine only that entities are different (equal to or not equal to); statistical analysis is not permissible; mathematical operations are not permissible.	colours; serial numbers.
Ordinal	The Ordinal scale can determine that entities are different and their relativity (greater than or less than), but no more; limited statistical analysis is permissible; mathematical operations are not permissible.	Rating and ranking figures of merit; hardness measures.
Interval	The Interval scale can determine that entities are different, can determine their relativity and can measure differences between entities, but no more; most statistical analysis is permissible; mathematical operations are permissible but limited to addition and subtraction (ratio operations not permitted).	Centigrade and Fahrenheit temperature scales (have floating zero points); calendars dates.
Ratio	The Ratio scale can determine that entities are different, can determine their relativity, can measure both differences between and the relativity of entities and; all statistical analysis is permissible; all mathematical operations are permissible.	Kelvin temperature scale (has absolute zero); Most continuous variables like distance, weight, speed.

[4] Research Concepts in Human Behaviour, C.C. Helmstadter, Prentice and Hall 1970

Utility

6. Utility is the perceived worth to the buyer of assessed Effectiveness of an offer.
7. While two or more individuals may assess Effectiveness of a product as the same, the worth of that Effectiveness to the individuals may differ markedly, eg how a millionaire and an ordinary worker may assess the utility of a Rolls-Royce.
8. An offer may not be fully compliant (not meet minimum requirements) but still have some utility, or an offer may exceed the maximum requirement, in which case a decision is needed about the real worth of the excess effectiveness. It is a common misconception that if an offer exceeds a maximum requirement, it must be worth more than an offer that just meets the requirement, when in fact excess effectiveness may not be of any value at all (utility drops to zero) within the operational context that the specification was framed. Principles of how Utility will be applied should be stated in advance in an evaluation plan.
9. The concept of utility is an important theoretical construct because it is the essential means of transforming statements of Effectiveness, made in one of the Scales of Measurement, to a value in the Ratio Scale.
10. The utility function can be continuous but will most likely be discontinuous across several ranges of Effectiveness. A two-range assessment would have only a minimum quality requirement ('pass mark') specified. A three-range assessment would have both a minimum and maximum quality requirement identified. But additional ranges for partial compliance levels could be defined as well.
11. Unfortunately, while Utility may be expressed as a mathematical function of Effectiveness, the validity of such a function would be difficult if not impossible to prove and, in practice, relative values of Utility need to be assigned subjectively. The utility curve remains only a perception in the minds of evaluators, which describes in qualitative terms the perceived worth of the Effectiveness of an option.
12. Given that a utility function cannot be validated, it follows that a 'value index' in the Ratio Scale cannot be validated. However, an implicit utility function that represents the best collective judgement of an evaluation team can be applied to transform Effectiveness into values in the Ratio Scale, to produce reasonable and defensible results (valid only for offers against an individual specification and for ratio comparison of an individual specification).

Non-Compliance of Essential Requirements

13. Non-compliances against Essential requirements can have very serious consequences for a tender, to the point of being set aside from further consideration and should be afforded special treatment compared to non-compliances against non-Essential requirements. Non-compliances against Essential requirements should be treated and resolved before further evaluation takes place.
14. The recommended process is as follows:
    - Determine Level of Compliance of offers for all lowest-level requirements {FC+, F, PC1, PC2, NC}.
    - Flag all lowest-level Essential requirements for which the offer is non-Compliant (E&NC).
    - Trace all E&NC offers up through the indenture levels to the first non-Essential requirement.
        - If an E&NC offer traces to the top of the tree, ie to the system, then the whole tender must be put aside (or the Essential designation reviewed).
        - If an E&NC offer does not trace to the top of the tree, ie to a lower-level requirement, then the non-Compliant requirement (Rx) is treated according to the rules below. Subordinate requirements to the non-Compliant Rx, whether Essential or not, are all non-Compliant.
    - Where at least one Essential requirement exists in a set of requirements, apply the following rules to all offers:
        - If an offer against any Essential, individual requirement in a given set of requirements {Rx} is non-Compliant, then {Rx} is Non-Compliant, irrespective of compliance of offers for other requirements in the {Rx} set, and so on up the tree. In this case, care needs to be taken to set all Effectiveness values to 'zero' for offers against requirements subordinate to the non-Compliant, Essential {Rx}.
        - If offers against all requirements in a set {Rx} are Compliant, then {Rx} is Compliant.
        - If offers against all Essential requirements in a set {Rx} are Compliant and offers against most non-Essential requirements in the set are Compliant, then consider {Rx} as Partially Compliant (Level 1).

- If offers against all Essential requirements in a set {Rx} are Compliant and some or none of the offers against non-Essential requirements in the set is Compliant, then consider {Rx} as Partially Compliant (Level 2).

- Where there is no Essential requirement in a set {Rx}, apply the following rules to all offers:
  - If offers against all Requirements in a set {Rx} are Compliant, then {Rx} is Compliant.
  - If no offer against Requirements in a set {Rx} is Compliant, then {Rx} is Not Compliant.
  - If offers against most requirements in a set {Rx} are Compliant, then consider {Rx} as Partially Compliant (Level 1).
  - If offers against most requirements in a set {Rx} are not Compliant, then consider {Rx} as Partially Compliant (Level 2) or even Not Compliant.

ANNEX B TO
EVAL_QUANT_10JAN22

EXAMPLE EVALUATION SPREADSHEET

TENDER EVALUATION - EXAMPLE SPREADSHEET

RFT PREPARATION

		Import	Wr	
Reqt	Requirement	E	1.00	Essential
Import	Relative Importance	H	0.60	Highly Desirable
Wr	Relative Weight	D	0.40	Desirable
Wrn	Normalised Rel. Wt.	I	-	Information

RESPONSE - TENDER X

FC+	12	Fully Compliant +	
FC	10	Fully Compliant	
PC1	8	Part Compliant 1	
PC2	4	Part Compliant 2	
NC	-	Not Compliant	

Cat	p(succ)	LOC	Le
N	1.00	Vr	Ra
L	0.90	Vw	W
M	0.80	Vwra	Ri
H	0.60	V/$	Va

Reqt LSN	Item	Scale	Rel Import	Wr	Wr	Wrn	Wrn		LOC	Vr Nom	Vr Adjust	Vw	Risk Cat	Risk p(succ)	Vwra	
0	System	Ord														
					3.00		1.00									
1	SSys1	Ord	E	1.00	1.00	**0.33**	**0.33**	0	FC	0	40.00	10.31			9.74	
				2.60		1.00										
1.1	aaa	Nom	E	1.00		0.38		0	FC+	12.00	12.00	4.62	N	1.00	4.62	
1.2	bbb	Ord	E	1.00		0.38		0	FC	10.00	10.00	3.85	L	0.90	3.46	
1.3	ccc	Ord	H	0.60		0.23		##	PC1	8.00	8.00	1.85	L	0.90	1.66	
1.4	ddd	Int	I	-		-		##	FC	10.00	10.00	-	L	0.90	-	
1.5	eee	Rat	I	-		-		##	NC	-	-	-	L	0.90	-	
2	SSys2	Ord	H	0.60	0.60	**0.20**	**0.20**	0	FC	0	40.00	9.06			9.06	
				3.40		1.00										
2.1	vvv	Nom	E	1.00		0.29		0	FC+	12.00	12.00	3.53	N	1.00	3.53	
2.2	www	Ord	E	1.00		0.29		0	FC	10.00	10.00	2.94	N	1.00	2.94	
3.1	xxx	Ord	H	0.60		0.18		##	PC1	8.00	8.00	1.41	N	1.00	1.41	
2.3	yyy	Int	D	0.40		0.12		##	FC	10.00	10.00	1.18	N	1.00	1.18	
4.1	zzz	Rat	D	0.40		0.12		##	NC	-	-	-	N	1.00	-	
3	SSys3	Ord	D	0.40	0.40	**0.13**	**0.13**	0	FC	0	40.00	12.62			10.09	
				3.80		1.46										
3.1	aaa	Nom	E	1.00		0.38		0	FC+	12.00	12.00	4.62	M	0.80	3.69	
3.2	bbb	Ord	E	1.00		0.38		0	FC	10.00	10.00	3.85	M	0.80	3.08	
3.3	ccc	Ord	H	0.60		0.23		##	PC1	8.00	8.00	1.85	M	0.80	1.48	
3.4	ddd	Int	H	0.60		0.23		##	FC	10.00	10.00	2.31	M	0.80	1.85	
3.5	eee	Rat	H	0.60		0.23		##	NC	-	-	-	M	0.80	-	
4	SSys4	Ord	E	1.00	1.00	**0.33**	**0.33**	0	FC	0	40.00	9.41			5.65	
				3.80		1.12										
4.1	vvv	Nom	E	1.00		0.29		0	FC+	12.00	12.00	3.53	H	0.60	2.12	
4.2	www	Ord	H	0.60		0.18		##	FC	10.00	10.00	1.76	H	0.60	1.06	
4.3	xxx	Ord	E	1.00		0.29		0	PC1	8.00	8.00	2.35	H	0.60	1.41	
4.4	yyy	Int	H	0.60		0.18		##	FC	10.00	10.00	1.76	H	0.60	1.06	
4.5	zzz	Rat	H	0.60		0.18		##	NC	-	-	-	H	0.60	-	

ANNEX C TO
Eval_Quant_10Jan22

DEFINITIONS

SN	Term	Definition
7	Effectiveness	Effectiveness is the performance of an offer against a given specification, as stated by the tenderer, preferably in the same units of measurement as that for the respective specification. Effectiveness may be in any of the four Scales of Measurement.
2	Figure of Merit (FOM)	A Figure of Merit is the quantification of the perceived merit of an entity in respect of a characteristic or attribute and its specified performance or quality criteria. A FOM may be in the Ordinal, Interval or Ratio Scale. Scores and indexes are examples of FOM.
11	Level of Compliance (LOC)	Level of Compliance is a statement of how an offer meets the respective requirement, relative to the specified minimum and maximum levels of Effectiveness. In this context, Levels of Compliance assume that a certain number of levels are defined rather than assuming a continuous function. A recommended set of Levels of Compliance is {LOC} = {FC+, FC, PC1, PC2, NC}, where: FC+ = Fully Compliant Plus (exceeds maximum requirement) FC = Fully Compliant (meets minimum requirement) PC1 = Partially Compliant – Level 1(could be made compliant at moderate extra cost) PC2 = Partially Compliant– Level 2 (could be made compliant at significant extra cost) NC = Not Compliant or Partially Compliant (could not be made compliant at acceptable extra cost)
4	Normalised Relative Weight of Specification	The Normalised Relative Weight of Specification is the Relative Weight of Specification expressed as a decimal of the sum of Relative Weights of Specification in the same set (at same level of indenture and to the lowest level in each branch of the specification tree,).
18	Qualitative	Using narrative argument.
8	Quality	Quality is (normally) defined as 'fitness for purpose' and is considered the same as 'Effectiveness' in this context.
17	Quantitative	Using numbers and mathematical expressions.
13	Ranking	Ranking is the placement of a number of entities in order according to some measure or notion of merit, using a figure of merit. Ranking is possible with values expressed validly in any of the Ordinal, Interval and Ratio Scales.
16	Raw Value	A Raw Value is the perceived Utility of the Effectiveness of an offer against a specification.
12	Relative Compliance Value	Relative Compliance Values are those assigned to the defined Levels of Compliance.
10	Relative Importance Designator	A Relative Importance Designator indicates the need for a specification to be met by an offer, in respect of the higher-level specification. Specifications (requirements) at all levels in the tree should always have a Relative Importance Designator assigned as it is essential to proper application of quantitative techniques. A recommended set of Relative Importance Designators is: {RID} = {E, H, D, I}, where: E = Essential H = Highly Desirable D = Desirable I = Information only.

		Any more than these categories is a waste of time and money in specification and evaluation. The Essential designator should be used with circumspection and only when called for. If in doubt, use Highly Desirable or Desirable.
9	Relative Weight of Specification	The Relative Weight of a Specification is that assigned to each specification in a set at the same level in a branch of a specification (requirements) tree, according to Relative Importance. The Relative Weight of a Specification has to be normalised before Weighted Values can be determined properly. Any scale may be used provided that the relativity is considered appropriate, given that weighted scores will be normalised. Particular attention must be paid to the relative weight of Essential requirements in the set. There is no one best set of relative weights. ***This aspect deserves study in its own right.***
5	Risk	In this context, Risk is the perceived likelihood that a supplier would in fact not make good the offer in respect of a given requirement, given the contract. It modifies the Weighted Value of an offer into a Risk-Adjusted Weighted Value. **Note:** Risk assignment should be applied only at the lowest level requirements in each branch of the requirements tree and is not applied at each higher indenture level, otherwise compounding of the risk assessment will occur. However, a narrative summary of lower-level risks would be appropriate. **Note:** In this context, risk is a probability only and, therefore, is used differently to the normally accepted meaning of risk, as defined in the relevant AS/NZS standard.
15	Risk-Adjusted Weighted Value	The Risk-Adjusted Weighted Value is the Weighted Value (of an offer) multiplied by the probability of success (1-Risk).
6	Scale of Measurement	A scale of measurement is a basis of reference by which entities may be differentiated and compared. Science recognises four scales of measurement: Nominal, Ordinal, Interval and Ratio.
19	Supplies	Supplies comprise all deliverables under a contract.
3	Utility	Utility is the perceived worth to the buyer of the Effectiveness of an offer.
1	Value	In this context, 'value' is defined as the perceived worth (usefulness) to the buyer of the Effectiveness of an offer (same as Utility).
20	Value Index	Value expressed as a Figure of Merit. In respect of an offer to meet a specification, the Value Index is a function of Effectiveness, Level of Compliance, Utility, the Normalised Relative Weight (of the Specification) and assigned Risk. Value Index [specification; tender] = Raw Value * Normalised Relative Weight of Specification * (1-Risk). VI [S;T] = Vr * Wrn * (1-R)
14	Weighted Value	The Weighted Value (of an offer) is the nominal Raw Value of an offer, in respect of the requirement, multiplied by the Normalised Relative Weight of Specification.