

# Webinar – An orientation to weighting

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### An orientation to weighting

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- 1. What is weighting and why does it matter?
- 2. What makes a good approach to weighting?
- 3. Weighting methodologies Deep dive into scaled comparison, pairwise, and CD4F
- 4. Putting it all together





# 1. What is weighting?

There are many elements in a procurement that contribute to the outcome you achieve:

<u>Contract – what you buy</u>

- Structure, T's & C's, basis of payment
- Performance Incentive Framework
- Statement of Work



#### Criteria - how you measure

- Mandatory
- Rated
- Scoring mechanism

<u>Overall procurement process – how you balance it</u>

- Basis of Selection
- Rated criteria weights
- Approach to Cost (Value for Money)





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## Weighting - example



How we weight criteria will affect the outcome of a competition

- Fuel economy, passenger room, and durability are all important
- But what is most important to you/your client?
- What does "GOOD" really look like?

#### Weights tell bidders what *rated elements* are important to you and to what degree!













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Weighting is how we allocate points in a competition to make a decision between the alternatives offered to us

*But* weighting is also a communications tool through which we motivate bidders to propose something to us that meets our objectives





# 2. What makes a good approach to weighting?

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#### Before you begin

#### Consider:

- Volume/nature of criteria
- Stakeholders experience, numbers, homogeneity
- Time available
- Available expertise / information
- What tools are available?
- Precedence & expectations





## Remember this is a human-led process

- Human limitations in identifying differences
- Biases good and bad
- Dynamics
  - Conformity
  - "Single-issue Zealots"
  - Silent majority/outspoken minority
- Emotions!



A good weighting approach acknowledges and respects these challenges!

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### How do we compare criteria?



Consider fruit...



Area (e.g. cm<sup>2</sup>) Sides (number/length) Roundness... Pointy-ness...



Sweetness- mg/100g fructose Calories - kcal/item Size... Transportability...

#### Some eval criteria:

- Training quality
- Schedule certainty
- Delivery risk
- Personnel capacity
- Access & availability
- Transport volume
- Analytics
- ...

What is the basis of comparison between criteria?



# 3. Weighting methodologies

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#### 100% subjective

- Stakeholders assign weightings based on experience
- Use this when:
  - Pressed for time
  - Small group of stakeholders
  - Overall risk of a poor outcome is LOW

#### – *But*...

- what is your basis of comparison?
- may not pass scrutiny by senior stakeholders
- can be difficult to get agreement
- prone to unintentional subjective bias









#### Scaled comparison – worked example later

- Criteria organised into a hierarchy
- Criteria in small sets are compared only with each other
- Resulting weights are then normalised throughout the entire structure
- Use this when:
  - Moderate to large number of criteria
  - Natural hierarchy of related criteria
  - Stakeholder groups aligned with criteria groups
- *But*...
  - What is your basis of comparison especially at higher levels?
  - Needs equivalence testing for assurance
  - Needs a calculator!



#### Pairwise comparison – worked example later

- Compares each criteria against each other criteria in pairs
- Mathematical process then translates these relative comparisons into weights
- Use when:
  - Small number of criteria
  - Easily compare one to another
- *But*...
  - What is your basis of comparison?
  - You need to be pretty good at math
  - Calculations makes the outcome hard to explain

	А	В	С	D	E
А	N/A	5	5	1÷5	7
В	0.20	N/A	1	1÷3	3
С	0.20	0.00	N/A	1÷7	1÷5
D	38/08/11/11/3			N/A	5
E	0.1.4	0.33		0.20	N/A





#### Commerce Decisions 4-Factor Method – more detail later

- An empirical method developed through experience by Commerce Decisions
- Apply 4 common bases of comparison to all criteria; scale and normalize
- Use when:
  - Complex criteria set
  - Moderate / large stakeholder groups
- *But*...
  - Requires experience to implement
  - Best when facilitated
  - Need a calculation tool

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Within the expected group of bidders, the measure	Scarce	Few bidders will be able to do this well		
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CERTAINTY	Full information	Complete clarity would allow a totally informed response		
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#### Inheritance

- Copied from previous similar projects
- Use this when:
  - Overall risk of a poor outcome is LOW
  - Historical precedence of successful outcomes
- *But*...
  - it ignores stakeholders and may not accurately appreciate new risks









#### Other methods

- Voting methods
- Reverse ranked average
- Principal component analysis
- Equivalence Analysis
- Quantitative methods
- Trial and error









### **Case Study – Complex Capital Procurement**

#### Complex projects often use multiple weighting methods:

- Mission performance weights set subjectively by expert judgement
- Production / Delivery Risk & Upgradeability weights set using CD 4F method
- Cost group and ITB / VP weights set by equivalence methods
- Technical group weights set using pairwise comparison
- Tier 1 weights set using advanced quantitative methods
- All weights rigorously tested with advanced sensitivity analysis



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# 3a. Scaled comparison Plus normalising weights

## **Scaled comparison**



- Break the hierarchy into "peer groups"
  - Start from the lowest level of the hierarchy
- Choose a criteria and give it a weight of **100**
- Set the weights of the others relative to this one to reflect their relative importance



## **Scaled comparison**



#### Work up the tree from the bottom of each branch.

- Compare the weights of the criteria within each peer group
- When comparing criteria with children, it will help to consider the scope (i.e. the relative comparison between the peer groups of child criteria)



## Normalising weights

It is now a simple mathematical job to calculate the percentage weight for each criteria:

- The head criteria has 100%
- Divide this 100% up at the next level down level in the proportions of the relative weights

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 $-W_{100} = Criteria Weight$  X head criteria weight%

Sum of weights in peer group

- Do this at each level down, using the head criteria weight as the % to multiply by



## Normalising weights



Complete throughout the hierarchy – giving each criteria a weight that relates right up to the head criteria



## **Resultant weights**



Once complete, the 100% of the project is divided into a series of criteria weights at the lowest level of the hierarchy, and it is these that go forward into the competition





## 3b. Pairwise comparison

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## What is pairwise comparison?



- Pairwise is the comparison of each element of the set with all the other elements of the set, one by one
- Assign a mathematical measure of relative importance between the items in the pair
- Capture the results in a matrix
- Using a prescribed algorithm, calculate the weight of each criteria

A scaling method for priorities in hierarchical structures T.L. Saaty Journal of Mathematical Psychology Vol. 15, Issue 3 (Jun, 1977), pp 234 – 281 (7 pages) Published by: Elsevier

https://www.sciencedirect.com/science/article/abs/pii/0022249677900335



## Intensity of relative comparison





Criteria A is "strongly" more important than Criteria B = assign value of 5

Criteria B "moderately" less important than Criteria D = assign value of  $1\div3$ 

The Fundamental Scale for Pairwise Comparisons				
Intensity of Importance	Definition	Explanation		
1	Equal importance	Two elements contribute equally to the objective		
3	Moderate importance	Experience and judgment moderately favor one element over another		
5	Strong importance	Experience and judgment strongly favor one element over another		
7	Very strong importance	One element is favored very strongly over another; its dominance is demonstrated in practice		
9	Extreme importance	The evidence favoring one element over another is of the highest possible order of affirmation		
Intensities of 2, 4, 6, and 8 can be used to express intermediate values. Intensities of 1.1, 1.2, 1.3, etc. can be used for elements that are very close in importance.				

#### Now some math

#### Deriving Weights from Pairwise Comparison Matrices J. Barzilai, Dalhousie University

The Journal of the Operational Research Society <u>Vol. 48, No. 12 (Dec, 1997)</u>, pp. 1226-1232 (7 pages) Published By: Palgrave Macmillan Journals

#### https://www.jstor.org/stable/3010752

Or search for: "calculating weights from pairwise comparison"

		В				Weight
А	N/A	5.00	5.00	0.20	7.00	35.14
В	0.20	N/A	1.00	0.33	3.00	9.26
С	0.20	1.00	N/A	0.14	0.20	3.15
D	5.00	3.00	7.00	N/A	5.00	40.86
E	0.14	0.33	5.00	0.20	N/A	11.60



## Pairwise comparison efficiency

In our example, 10 comparisons were needed to compare 5 criteria (A-E)

Weighting **20 criteria** using pairwise comparison requires... **190** head-to-head comparisons Weighting **100 criteria** using pairwise comparison requires...

4,950 head-to-head comparisons

Plus, you need to record the reason for each comparison result

Math alert: if you have N criteria, the number of comparisons needed are:



N(N-1)





### Why use pairwise

- Breaks weighting problem into small individual decisions
- Forces you to look at criteria from different perspectives
- Academically robust



- Pairwise can result in inconsistent statements, as in the following comparisons:
  - Direct: "A is more important than B" and "B has the same importance as A".
  - **Triangular**: "A is more important than B"; "B is the same importance as C"; "C is the same importance as A" is inconsistent.
- *But...* 
  - Mathematics are complex and the outcomes can be difficult to defend.
  - More challenging as criteria numbers rise
  - Need a tool to record comparisons and calculate results





### Should I use pairwise?



So, consider carefully before proceeding with pairwise comparison – and consider getting help

There is a White Paper on pairwise, available from the Commerce Decisions website:

https://commercedecisions.com/resource/pairwisecomparison-an-objective-review/





## 3c. Commerce Decisions 4-Factor method



What we *saw* project teams consider when comparing criteria in weighting



Impact of criteria on overall project outcome

What project teams *should* consider when comparing criteria in weighting



Impact of criteria on overall project outcome Degree to which criteria is a proxy for desired outcome Depth and breadth of evidence required in bid response Depth and breadth of information provided by project Criteria scoring method / scale Related mandatory criteria Spectrum of Market offerings Other risk control mechanisms in project Temporal aspect of risk/benefit



#### Identified four FACTORS that can be universally applied for any criteria to act as basis of comparison

#### IMPACT

The extent to which the lack of this capability or solution would affect the overall objectives of the project.

How likely is it that the Authority could rectify the deficiency by other means?

#### **DISTINCTIVE CAPABILITY**

Within the expected group of bidders, the measure of difficulty that Authority anticipates that each would have in scoring 'Excellent Confidence'.

#### CERTAINTY

A measure of the level of information available to bidders to enable them to formulate a response.

#### IMMEDIACY

The extent to which the question relates to current or future demands on bidders (from the date of contract award).



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#### Method:

- 1. Each factor is assigned a multiplier.
- 2. Each level within each factor is assigned a value.
- 3. Each evaluation criteria is considered one at a time against the 4 factors
- 4. Using the word pictures, the criteria is assigned one of four levels within each factor
- 5. Generate unscaled weights by adding up the factor multipliers by value levels
- 6. Normalise weights across all criteria

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# 4. Putting it all together

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#### Weighting development process 3 Steps



#### Prepare

- Write and refine the criteria
- Fix the number of criteria
- Agree which are for 'compliance'
- Write down weighting methodology

#### Initial weighting

- Manage stakeholder participation
- Derive weights and discuss in committee
- Record results and capture observations
- If necessary, adjust weights and record reasoning

#### Test and refine

- Using derived weights
- Describe expected or hypothetical bidder responses
- Run multiple bids at weighted criteria
- Decide whether the scenario gives an optimal or satisfactory outcome
- If not adjust weights until it does

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## More than just the answer – justifying your work

- Process and the resulting weights must be: defensible
  - To project team(s)
  - To bidders
  - To leadership
  - To media/public
  - To legal scrutiny
- Process and the resulting weights must be: repeatable
  - Objective even if it is qualitative
- Document everything!
  - Approach
  - Decisions
  - Rationale
  - Changes





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- Relative weighing of criteria is a key part of the algorithm used to select the preferred supplier or winning solution, and may be subject to challenge
- A written narrative to describe the methodology is essential if you want to be able to defend it
- 3 step process:
  - 1. Prepare
  - 2. Set Initial Weights
  - 3. Test & Refine
- There are choices of method as to how you weight evaluation criteria. Not all options are equal or will be suitable for your situation. Make an informed choice, but try not to over complicate it (more complex is not necessarily better)
- Stakeholder and senior management participation is key think early about how you're going to organise the team participation and manage that expectation





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