



SKA Tradeoff Processes

P. Dewdney

System Delta CoDR

Feb. 23, 2011



Outline

SPDO

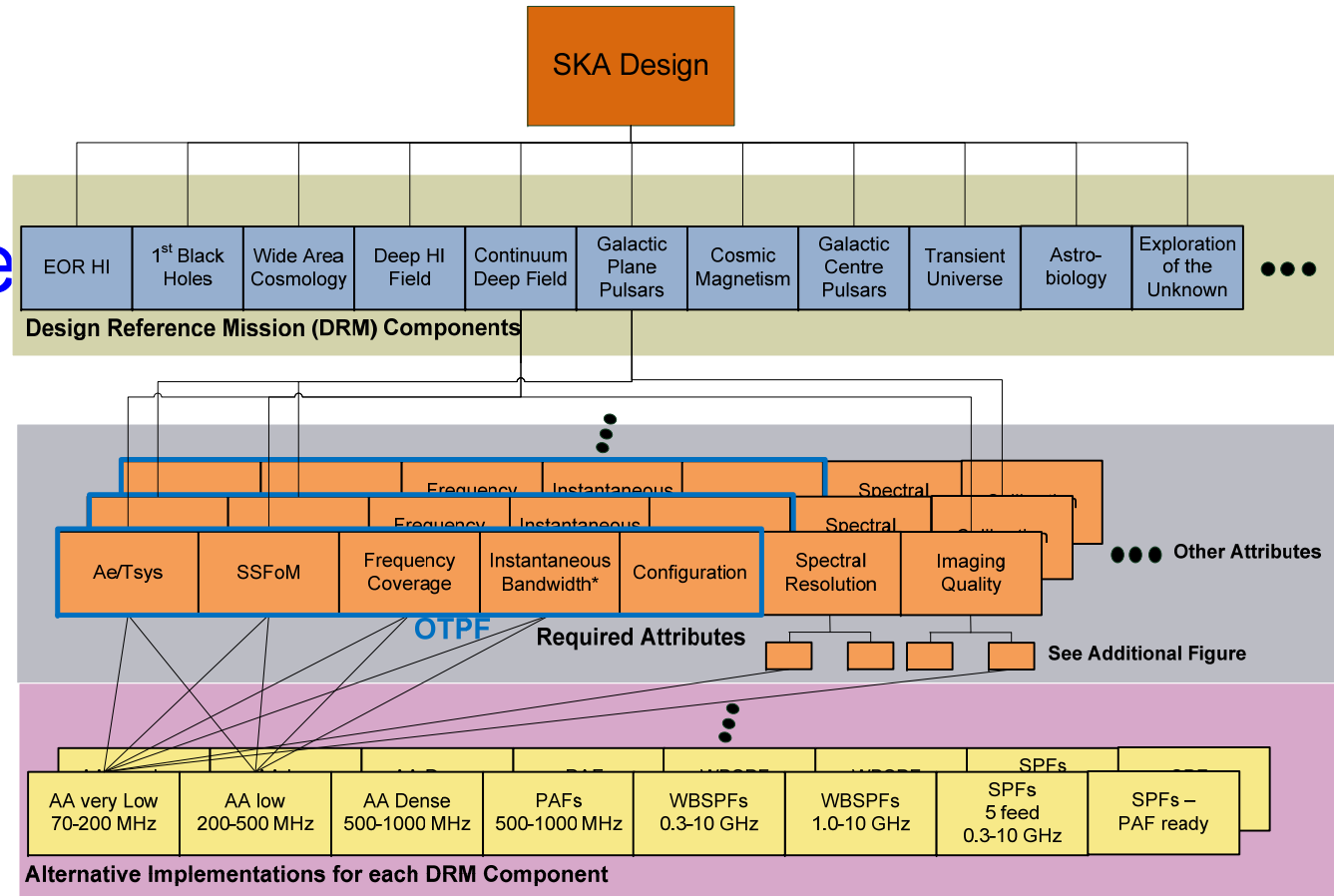
1. Why a process of selection is needed?
2. Technology selection and interaction with science.
3. A proposed decision-making process.



Desirable Characteristics of Decision-making Process..... SPDO

- Unbiased – uses objective criteria as much as possible.
- Based on performance/cost ratio for meeting science goals.
- Can take into account relative cost and total cost.
- Can accommodate and track a wide variety of criteria, including non-numeric experience-based wisdom.
- Capable of accommodating ranked science goals.
- Can accommodate and track changes of criteria, evidence, etc over time.
- Robust method – shows smooth dependence on criteria.
- Can accommodate interactions between choices.
- Simple enough to be understood easily (ie, makes sense intuitively).

Decision-Making Tree Structure

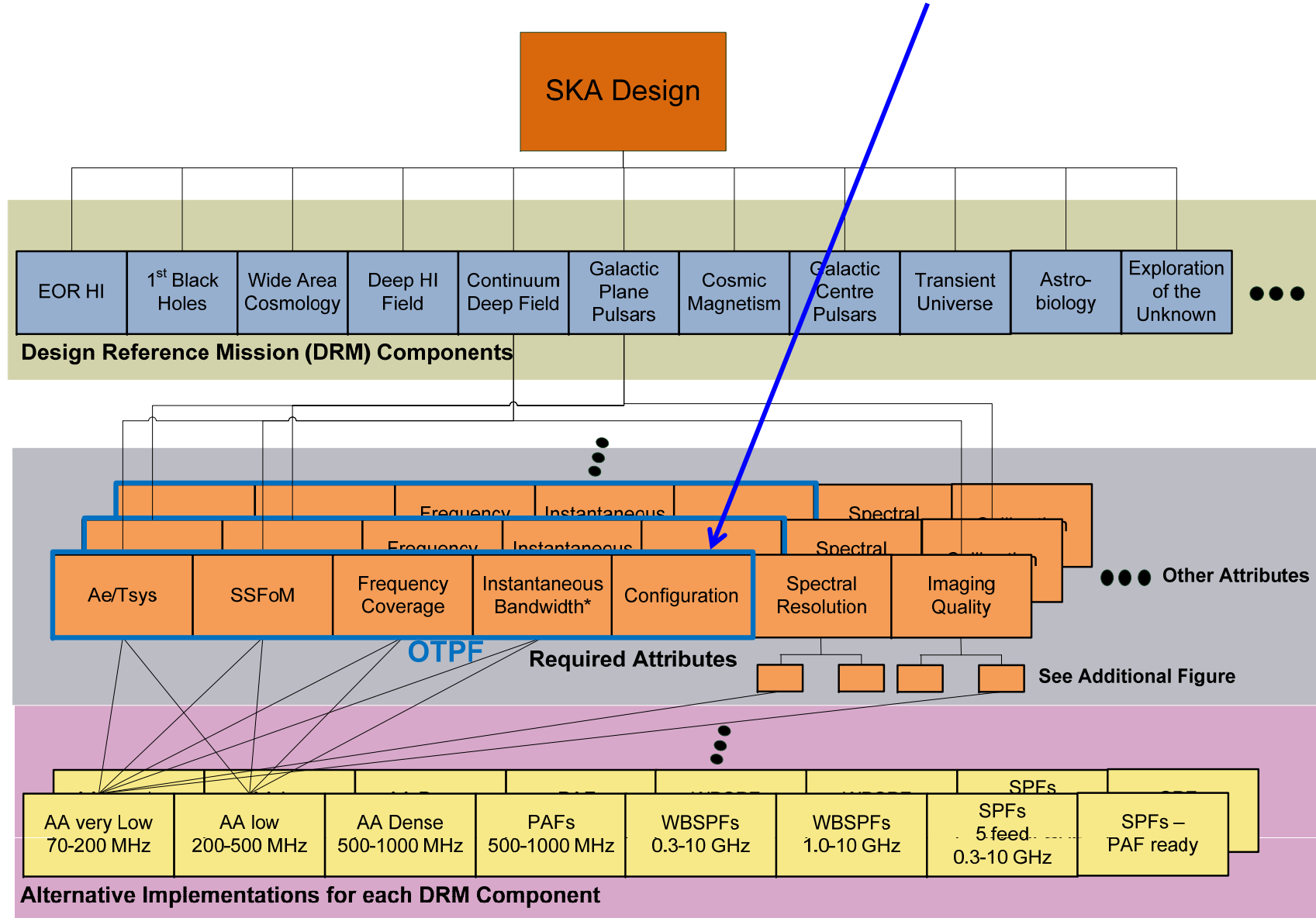


- Top box = overall objective (SKA Design).
- Second row = RSP components.
- Middle rows = attributes, one set for each RSP component.
 - Technical requirements derived from the science.
 - May contain additional hierarchy levels.
- Bottom group of rows contains implementation technologies.

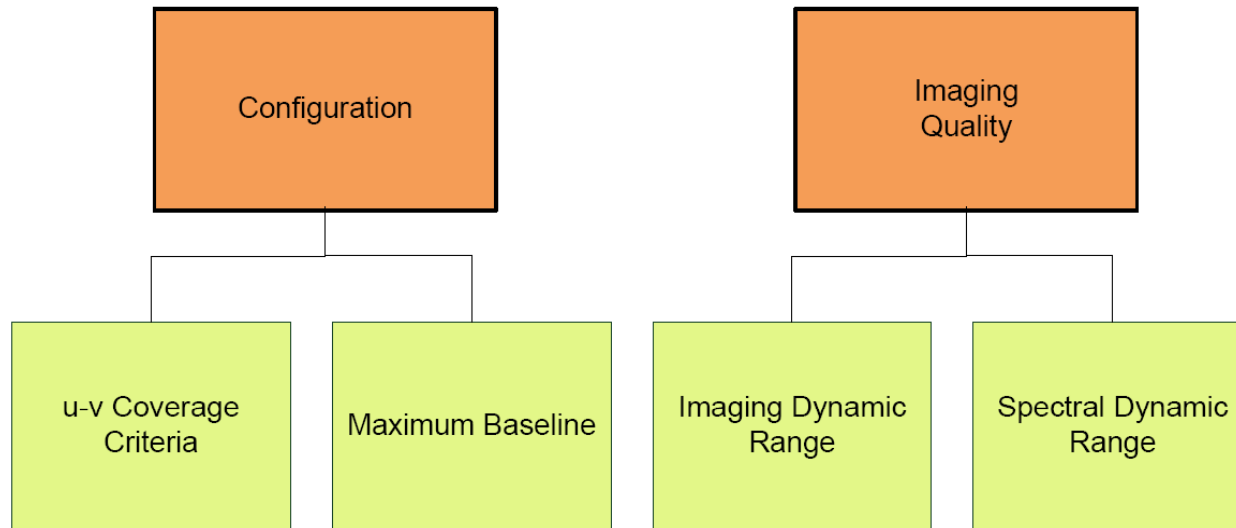


Attributes Contained in OTPF

SPDO



* Included in OTPF only for Continuum Observations



- Scores for the lower tiers are averaged to form a score for the next tier above.



Observing Time as a Metric

SPDO

- Simpler metric than all four metrics separately.
- Any required survey area and/or depth can be reached by integrating for longer, provided that noise continues to average down and the confusion limit is not reached.
- From an economic perspective, observing time is essentially the same as determining the fraction of the total investment in the telescope to be used for the project in question.
- In the current version most (but not all) components of the DRM have been described so that they can be observed in two years of “on-sky” time.



Spreadsheet

SPDO

2 Resolving AGN and Star Formation in Galaxies					
Parameter	Value from DRM	Min Spec	Max Spec		Comment
baseline	>3000	200	3000	km	Brightness temperature
Survey area	1000	1000	1000	deg ²	Cosmic volume (at z ≈ 2)
Survey speed	1000	1000	1000	deg ² m ⁴ K ⁻²	Cosmic volume, radio luminosity spectral density (f < 2GHz)
Frequency	0.5-8	0.5	8	GHz	Spectra and opacity
Flux density	6	6	6	μJy	Derived
Imaging dynamic range	42	42	42	dB	Brightness temperature
Bandwidth	1	1	1	GHz	Assumption for sensitivity calculations

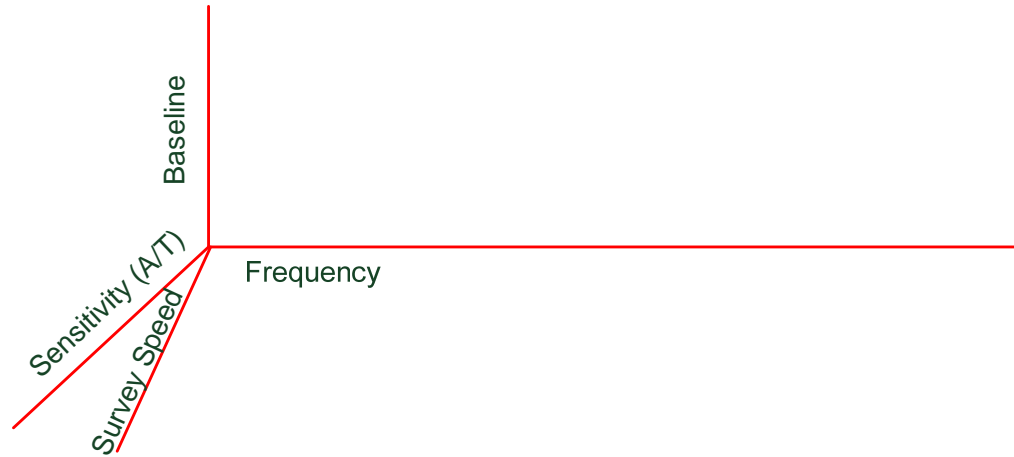
Realized Sensitivity (in fractions of maximum)	Realized Survey Speed	Realized Bandwidth GHz	Notes	OTPF Contributions	OTPF	OTPF is the factor by which the total observing time must be multiplied to complete the project.
			Available RF bands	(<1 is speedup)		
			TBD			
TBD	TBD		TBD	Passes	TBD	
			TBD	Bandwidth	TBD	
				Sensitivity	TBD	
				Net	TBD	8



Must Select a System to be Evaluated SPDO

“Menu”

AA very Low 70-200 MHz	AA low 200-500 MHz	AA Dense 500-1000 MHz	PAFs 500-1000 MHz	WBSPFs 0.3-10 GHz	WBSPFs 1.0-10 GHz	SPFs 5 feed 0.3-10 GHz	SPFs – PAF ready
---------------------------	-----------------------	--------------------------	----------------------	----------------------	----------------------	------------------------------	---------------------



Examples

1

AA very Low 70-200 MHz

AA Dense 500-1000 MHz

WBSPFs 1.0-10 GHz	SPFs 5 feed 0.3-10 GHz
----------------------	------------------------------

2

PAFs 500-1000 MHz	WBSPFs 0.3-10 GHz	WBSPFs 1.0-10 GHz	SPFs 5 feed 0.3-10 GHz
----------------------	----------------------	----------------------	------------------------------

3

AA very Low 70-200 MHz	AA low 200-500 MHz	AA Dense 500-1000 MHz
---------------------------	-----------------------	--------------------------

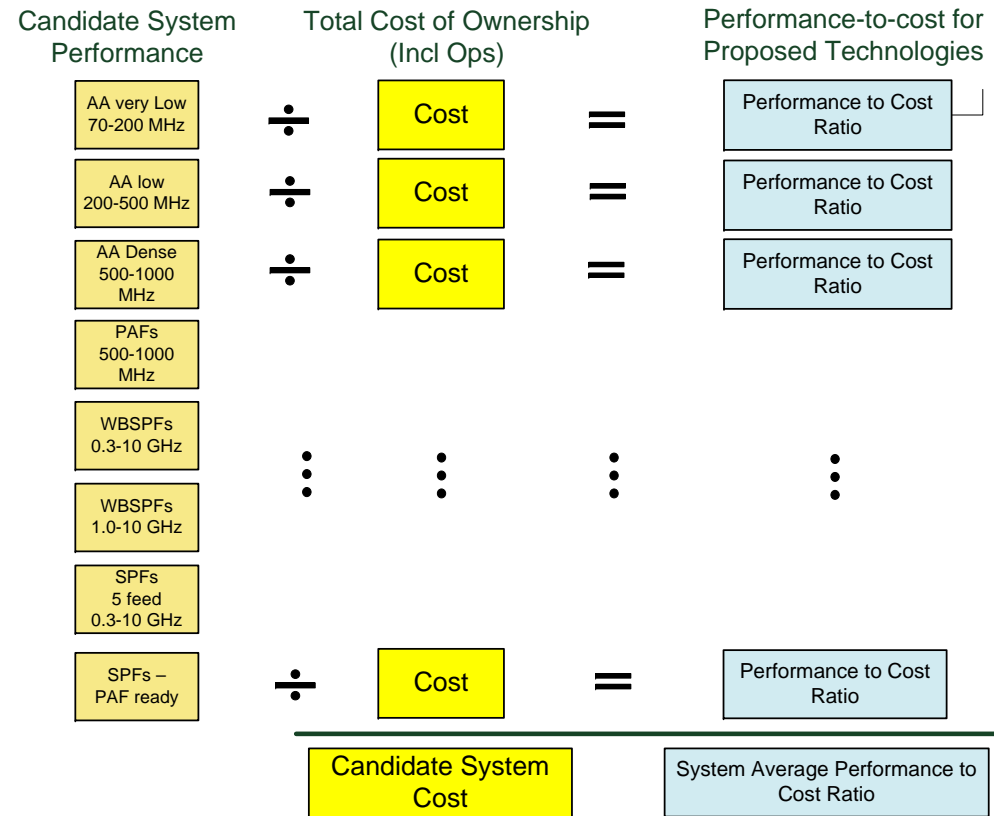
WBSPFs 0.3-10 GHz	WBSPFs 1.0-10 GHz
----------------------	----------------------

4

AA very Low 70-200 MHz	AA low 200-500 MHz	AA Dense 500-1000 MHz
---------------------------	-----------------------	--------------------------

WBSPFs 1.0-10 GHz	SPFs 5 feed 0.3-10 GHz	SPFs – PAF ready
----------------------	------------------------------	---------------------

Combining Cost & Scores



- Left column: scores for each technologies,
 - weighted average over DRM components (aggregate performance).
- Middle column: total cost of ownership for each technology.
- Right column: performance-to-cost ratios.
- Also should be done for each DRM component separately
 - provides information on outliers
 - e.g very expensive or very inexpensive combinations.

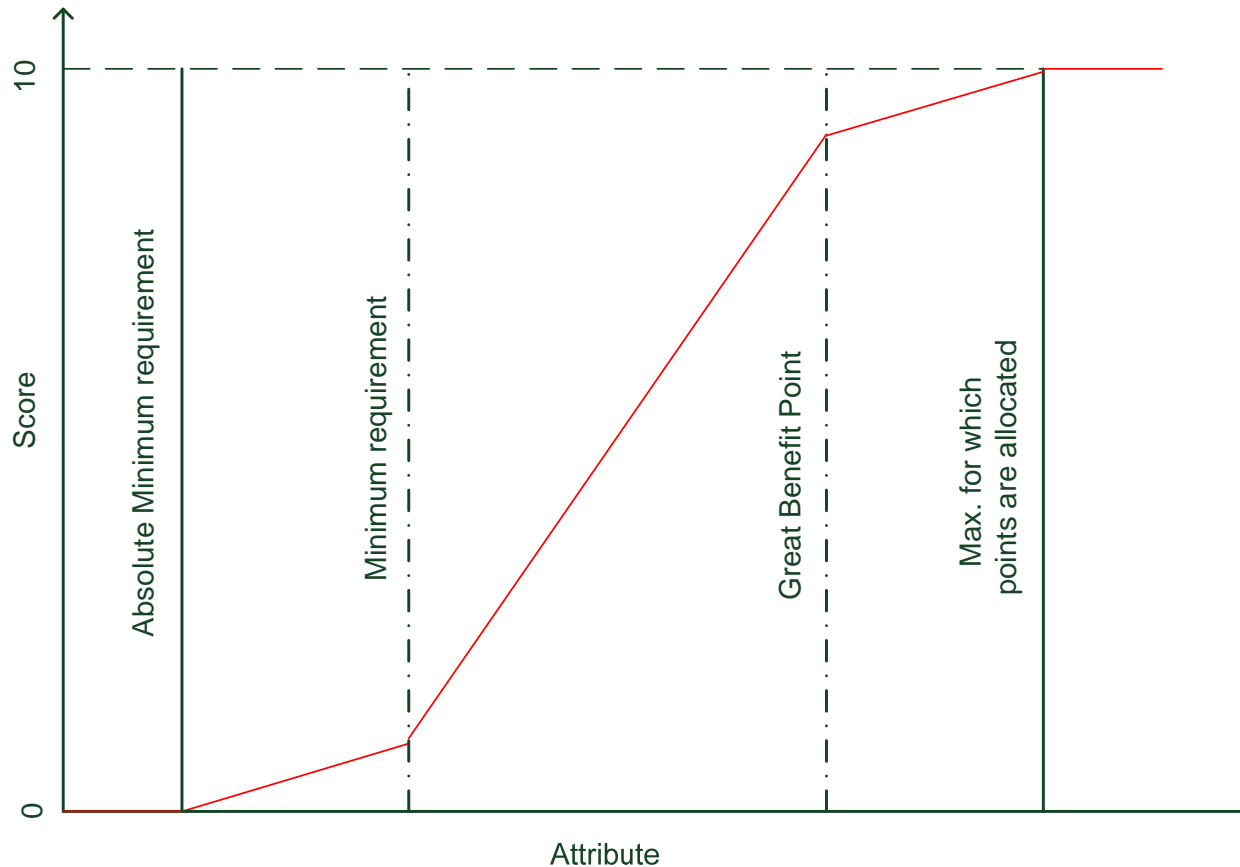


Costs

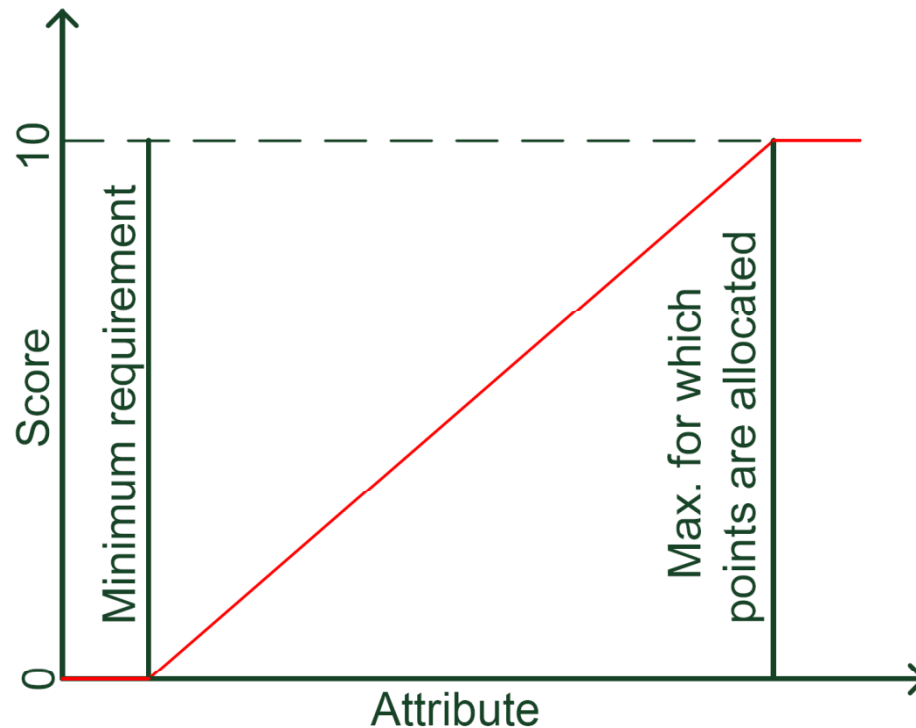
SPDO

- Cost have to include supporting infrastructure and maintenance for same.

4-Threshold Method of Score Assignment SPDO



- Non-linear assignment of scores; two stage scoring.
- Used in a situation where it is better to continue to consider a particular technology, whereas it would otherwise be eliminated because of failing, for example, one criterion.



- Minimum score assigned if the performance attribute meets the minimum requirement.
- Maximum score assigned once the attribute exceeds an amount beyond which it no longer adds scientific benefit.

- Decision-making methods do not replace “wisdom”.
 - They are a tool for keeping track of wisdom.
- The method proposed here is
 - Not unique.
 - Somewhat sensitive to what is allowed in the science pool and in the technology pool.
 - Expertise is needed to set up the choices properly.
- Process should be carried out repeatedly, updating weights as new information comes in or requirements change.
 - Until we have to make technology selection decisions.

End