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PAIRED COMPARISON: WHY TOOLS AND TECHNIQUES FIT WITHIN THE VALUE METHODOLOGY.

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ABSTRACT

The explanation of techniques such as Paired Comparison often reveals a view of procedures and rules described in a quasi algorithmic fashion as a series of steps; first do A, then do B, et voila! This 'how to' approach seeks to 'train' people rather than 'how and why' approaches that educate them. Such a limited 'competence' focus often traps newcomers into the performance of an algorithm without fully understanding 'why it has relevance'. For newcomers to our disciplines, the need to gain qualifications such as AVS and CVS in the hope of greater job security and career advancement can place them in a master-servant relationship with those, possibly without realising it, that promote narrow and unconnected views of practice designed around episodic consulting engagements. For example, some experienced practitioners ask "Which attribute is most important?" in the use of Paired Comparison and inadvertently direct the study-team's attention away from a sense of the customer's *values-importance* (i.e. what's important to customers-purchasers, the product is intended to wow) and erroneously promote an internal view of *values-importance* based on considerations not necessarily relevant to the focus of the Value Study (i.e. what's important to manufacturers-providers trying to ensure the efficient deployment of resources).

This paper uses the case of Paired Comparison to articulate the links between 'tools and techniques', the process they are used within (e.g. VE), the guiding framework provided by the Value Methodology and the philosophical theory which gives credence to a synthetic view of reality that functions.

It will also suggest an alternative approach to the 'training' agenda be brought into our society through the concept of 'Reflective Practice' and mentoring. This supplementary approach to learning will enable a different relationship between learners, both newcomers and established VE,

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VA and VM masters, all at different stages of the same educative and formative journey. It is an approach to learning in which dialogue forms the means to better understanding of tools and techniques in relation to the transformation of functioning (i.e. innovation) so as to liberate more value.

INTRODUCTION

The central theme of this paper is about how techniques and practice are joined in the training of VE facilitators and how such should be focused on improving an organisation's ability to innovate. It is a critique of practice which detaches the logic of various techniques from the combining logic of the VE Job Plan. Such detached explanations devalue the potential of VE as the students fail to grasp why they do such and such. Furthermore, many modes of assessing capability (e.g. AVS Exams) emphasise the student's ability to remember facts. Few assessment modes examine whether the student understands how to use techniques in practice and how such techniques correspond to both reality and the team's understanding. We hypothesise that this is a product of a weak understanding of what constitutes 'learning'. It is from this weak understanding of what 'learning' is that various training programmes from many value societies, not just SAVE International, fail to enable a capability that then generates subsequent stages of VE development inside organisations; it is offered as an explanation of why VE often gets stuck and losses appeal after a while as it is treated as a product rather than a process for team-thinking.

Ramsden (1992: p.26) found five types of learning existed for adults:

1. Learning as a quantitative increase in knowledge. Learning is acquiring information or 'knowing a lot'.
2. Learning as memorising. Learning is storing information that can be reproduced.
3. Learning as acquiring facts, skills, and methods that can be retained and used as necessary.
4. Learning as making sense or abstracting meaning. Learning involves relating parts of the subject matter to each other and to the real world.
5. Learning as interpreting and understanding reality in a different way. Learning involves comprehending the world by reinterpreting knowledge.

It seems as if the VE community, and we speak of all VE and VM societies, have focused on the first three types of learning. However it is 4 and 5 that mark the difference between average and great learning. Many will argue that in training episodes such as Mod I and Mod II the last two types of learning are strongly present. However, when we look to the examinations, the modes by which we test learning, we see that it is the first three that feature strongly. If what has been stated so far is accepted then we argue that a richer view of 'learning' is a key feature we as a community of practitioners must put right. Here we call for mentoring and reflective practice to be officially recognised as key ways of training VE facilitators. Let us now explore why we feel a joined-up view to learning and practice is necessary.

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The VE Job Plan is not a collection of unconnected blocks and an educative approach to it, rather than a training approach, should develop both competence and capability. We should encourage a joined-up logic which enables learning that allows newcomers to understand ‘why’ particular techniques are included in the VE methodology. The Job Plan is more akin to a stage gate process for innovative thinking. The Job Plan structures multi-disciplined conversations aimed at improving a project, product or service. It is founded on a belief that all things of value derive that ‘value’ out of their functionality. To improve a ‘thing’ we must find better and more elegant ways to perform functions. The stages within the Job Plan are:

Pre-Event: Define how success will be recognised.

Event: The traditional VE workshop stages

Information Stage: Understand what is going on and with Function Analysis and FAST models make explicit how things work.

Creativity Stage: Generate a list of alternative ways functions can be performed.

Evaluation Stage: Identify potentially good ideas and conduct a research study to make them more reliable predictors of what is likely.

Development Stage: Combine mutually inclusive ideas to build a list of alternative scenarios.

Presentation Stage: Enable investors to select and fund a new and improved way forward.

Implementation Stage: Enable the team to adapt as reality conditions anticipations of what ideas will really be like.

Post Event

After Action Review: As a team, learn how to improve the way the VE episode could be improved next time.

A CLOSER LOOK AT THE PRE-EVENT STAGE

This section of the paper will emphasise the need for techniques and methods to be seen as part of a complete methodology we call VA, VE and VM. This is fundamental to the way we learn VE and assess that learning. In this preliminary stage of the Job Plan the strategic opportunities, problems and issues are articulated as well as tested against external evidence sourced from outside the VE team (Kaufman, 1998). The aim of this stage is to define a view of success the VE team should aim for. It is where senior managers (e.g. Internal Customers) communicate the objectives and priorities they want to steer the innovation process. It is only when a general description of the destination is agreed amongst customers that the remainder of the Job Plan should be undertaken. If this is not done properly then the VE effort could end up solving the wrong problem or worse solving nothing meaningful at all. It is in this stage that three key “Opportunity Framing” questions are asked of the customer:

1. What is the opportunity or problem we seek to address?
2. Why has the opportunity or problem arisen?
3. What would happen if we did nothing?

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Another three core techniques combine to characterise and communicate customer expectations. They are:

Range of Goodness Matrix
Paired Comparison Technique
Value Score Calculation

In the Pre-Event, attributes are defined and a range of potential outcomes mapped (see table 1). Customers decide where the innovation effort is best targeted using Paired Comparison (see figure 1). Where the likely outcome is seen, based on today's predictions, is positioned on the "Range of Goodness Matrix" (see grey cells in table 2) and this becomes the "Base Case." The weighting for each attribute, drawn out of the Paired Comparison (see figure 1) is then multiplied by the relative position from within the "Range of Goodness Matrix" to establish a Value Score that acts as a datum.

At the end of the Pre-Event stage it should be possible to accept or reject a combination of ideas as being likely to cause improvement. Its role is to enable a combination of ideas to be recognised as creating value or not.

The Job Plan is a term that refers collectively to the above stages in the VE methodology (see previous section). It is a logically 'joined-up' series of stages in a thinking process aimed at creating more value through innovation. Within each stage various techniques move the thinking forward by working in concert. By 'joined-up' we mean each stage enables the next one to progress. The output of each of the stages provides anchor points that may expand or limit the potential for significant improvement. If any stage is undertaken with a detached logic then its role in the guiding framework may be compromised. The techniques serve and are served by other techniques all of which are embedded in the VE Job Plan. Inadequate thinking that loses sight of this logical connectivity will cause the whole innovation process of VE to be weakened. We are clearly making this 'synthesis' a key part of our founding premise for the Job Plan and the techniques within it. We will now turn to consider one particular technique, Paired Comparison, to explain how in practice a detached logic is sometimes used and that it undermines the potential of the VE Job Plan. We will not cite publications nor name individuals as to do so would cause embarrassment that will get in the way of our true ambition, to improve the capability of VE practice. If we create a blame culture then individuals will be forced to defend themselves instead of engaging in 'learning'.

WHAT IS PAIRED COMPARISON?

Paired Comparison is a technique used in the Pre-Event stage of the VE Job Plan that is inextricably linked to three other techniques; Opportunity-Problem framing questions, Range of Goodness Matrix and the calculation of a Value Score. Readers unfamiliar with these techniques are referred to Woodhead and McCuish (2002). The aim in this paper is not so much to explain 'how' the techniques are performed but 'why'. The function of Paired Comparison is along the lines of '*Communicate Customer Priorities*'. It does so by enabling the customer to weight attributes so that in trade-off decisions their value judgements direct the VE team's ingenuity.

WHAT IS AN ATTRIBUTE?

The purpose of an attribute in VE is to define and measure value before and after VE has been conducted. Keeney (1996) defines an attribute as a “measure of effectiveness”, a “measure of performance” and a “criterion”. He states:

As an illustration of the notion of an attribute, consider a simple example. The objective of a firm to maximise profit can be measured by the attribute “annual profit in millions of dollars.” Although in this case it is easy to specify an attribute, often the process is difficult.

Keeney also explains how the definition of attributes is implicitly a value judgment. Should we as managers react to all incidents or accept some are random events that whilst unfortunate, can be ignored? Upon what basis should we choose to do something or not? In an extreme example, the number of mortalities due to road accidents might lead us to scale as if each individual incident, such as the death of an 80 year old pedestrian and a 5 year old pedestrian are equivalent. Such extreme situations are faced by many managers grappling with tough decisions as they try to do the right thing with insufficient resources and funds. However as managers we need to question our assumptions so as to prioritise solutions realised out of scarce resources. If we reduce the effects of one problem by allocating resources then we divert those resources away from other problems. In a similar case to the road accident example above, Keeney poses the possibility that “total expected years of life lost” may be a better attribute for the objective of “minimise life lost.” In an ideal world such asymmetric value judgements would be unnecessary, but we do not live in an ideal world. We must accept that our response to problems and issues are value judgements often made under uncertainty. For Value Engineering the topic of ‘Value’ is central to its own identity and what it does; it’s about improving situations so that greater value is achieved. The reality is that budgets are limited and how we spend money to improve things is made on the basis of priorities and it is the notion of ‘priority’ that opens the door to discussions about ‘values’ and ‘value’. Attributes are thus ways we use to characterise what we mean by the word ‘value’ in a particular situation. They enable us to rationally show how we prefer one solution to another and provide a means to argue what value results from such improvement.

Keeney also distinguishes between three types of attribute that we will try to explain.

Natural Attributes: The units of measurement flow directly out of the objectives such as an objective of “Minimise Cost” would lead to an attribute of “Cost measured in dollars”.

Constructed Attributes: These are developed for a specific context such as to describe the different constructability issues associated with a proposed chemical plant in an already overcrowded and fully operational site. The different categories could range from “Easy Constructability” to “Difficult Constructability” and would relate specifically to the constructability issues relevant to that particular site.

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Proxy Attributes: Sometimes we have to use proxy measurements as direct correlation is difficult. For example, an objective of “Increase public awareness of Value Engineering” could lead to an attribute of “Column inches published in magazines.” The inference is that the measurement of the proxy attribute implies the objective is being assessed.

PAIRED COMPARISON CASE STUDY

Let’s build a hypothetical case study that will allow us to examine the use of Paired Comparison in the VE Job Plan. We will suggest that a customer is to procure a new chemical plant that will be manufactured in modules and will push-fit together thereby removing the need for site based construction personnel such as welders. Whilst this is unlikely in today’s construction markets and cost efficiency drives, this hypothetical case will enable us to demonstrate ‘how to’ and ‘how not to’ conduct a Paired Comparison. At the heart of this will be an examination of both a joined-up and a detached logic as to how to run a Paired Comparison. Let us accept the following attributes have been established from a strategic enquiry (See Woodhead & McCuish, 2002)

Category Attribute	1	2	3	4	5	6	7	8	9	10
Capex (\$ M)	92	91	90	90	89	88	87	86	85	84
Opex (\$,000/ Yr)	440	430	420	410	400	390	380	370	360	350
Schedule (WKs)	140	120	105	98	93	88	85	83	82	81
Risk of Accidents (% Prob)	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	5 %	0 %

Table 1: Range of goodness for attributes

Capex, Opex and Schedule are “Natural Attributes” that flow out of objectives such as ‘Optimise Cost’ or ‘Optimise Programme’. “Risk of Accidents” is a “Proxy Attribute” that we can assume is the product of probabilistic assessment made by Health and Safety experts in conjunction with Construction Managers. It could be based on the envisaged number of operations in which construction workers would be exposed to the possibility of injury. The numbers in the table represent a range of targets that have been set by the customers.

Column One represents the lowest level of performance the customer is willing to accept. So the customer would accept a Capex of \$92 million but should that rise to \$93 million the project would probably be cancelled. Column Nine represents examples of “Best Practice” drawn from similar projects and helps us to establish what a stretch goal would look like. This involves benchmarking a group of comparable projects. Not every benchmarked project will necessarily achieve the best result on every attribute. This is acceptable because our goal is to define success in ways that lead to competitive advantages. Column Ten represents a performance capability that has yet to be achieved in practice, but which is feasible based on evidenced ‘excellence’ cited in Column Nine.

Table two shows greyed cells which represent the position the current design is heading towards. We will call this combination of targets the “Base Case.” The grey cells are the most likely prediction for the outcomes to be achieved by today’s performance and trend line analysis; for

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example, the current design is expected to cost \$90M with an Opex of \$400,000/year (Say 15 year time horizon at 10%).

Category Attribute	1	2	3	4	5	6	7	8	9	10
Capex (\$ M)	92	91	90	90	89	88	87	86	85	84
Opex (\$,000/ Yr)	440	430	420	410	400	390	380	370	360	350
Schedule (WKs)	140	120	105	98	93	88	85	83	82	81
Risk of Accidents (% Prob)	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	5 %	0 %

Table 2. The Current Base Case.

Having described the Range of Goodness Matrix let's turn to consider "Paired Comparison". We assume the reader is familiar with the mechanics of this technique and refer those who are not to the literature (e.g. Kaufman, 1998, Woodhead & McCuish, 2002). Essentially Paired Comparison is a technique that forces a collection of people to discuss which attribute is to be improved in preference to others. Attributes are considered in a pair-wise process with questions such as "Which should we improve Capex or Opex?" The resultant conversations should explore the predicted consequences with respect to the project. If the team picks Capex then the next question to be asked enquires about the size of added value that would be achieved if Capex were improved. Often three categories are offered:

1. Slight benefit
2. Moderate benefit
3. Major benefit

Figure one shows how an assumed customer might set preferences if the question "Which is most important?" is asked. Later we will use this figure to prove it is incorrect with respect to the VE Job Plan.

What must never be ignored is that as customers control revenue, it is their value judgements we are modelling. To assume we know customer preferences could be very expensive if wrong. The end-customer who puts money into a supply chain as they purchase in the high street is the ultimate key to success and they should be involved in setting the priorities. We must involve customers in the Pre-Event as they decide what counts as value.

VE DEALS WITH A SYSTEMIC LOGIC

Another mistake often made when undertaking Paired Comparison is a failure to understand that the attributes are often systemically linked. If we reduce the quality of a new building by procuring inferior products (i.e. reduce Capex) then the probability rises that 'in-use' maintenance costs will rise (i.e. increase Opex and Life Cycle Costs) during the building's life. If Capex justifiably rises (i.e. ignore externalities such as inflation) we would expect to see Opex fall. Similarly, if Capex falls we would expect to see Opex rise. A comparable causal theory unites Capex and Schedule. If

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we spend more money to build faster either by increasing manpower on site or manufacturing for faster assembly off site, we should see scheduled completion dates brought forward in the calendar. The same applies to Capex and “Risk of Accidents.” If we spend more money to obviate the need for construction personnel to be exposed to operations then we should expect to see the “Risk of Accidents” fall. However, we cannot argue a causal link between “Opex” and “Risk of Accident” as both occur in different time periods as we have defined them as attributes. So not all attributes in Paired Comparison are necessarily linked but the fact some may be requires us to enquire into the systemic relationships. It is important to see that the attributes we weight in Paired Comparison reflect a complex reality that is often interconnected. The VE Job Plan links the team’s thoughts to an envisaged reality. To treat attributes as detached statements fails to grasp that systems are at play and so devalues the potential of the Paired Comparison’s role in the VE pre-event.

THE ERROR OF IGNORING THE JOB PLAN

A common mistake in VE practice is to ask, “Which attribute is most important?” This question loses sight of the role Paired Comparison plays with other techniques in a synchronised effort to achieve improvement through innovation. Given our choice is between Capex, Opex, Schedule and “Risk of Accident”, most people would place ‘people’ before profits and thus promote “Risk of Accident” to be the most important attribute (see figure 1). In doing so they have anchored within ‘moral values’ as opposed to ‘economic values’. Whilst commendable this is not directly relevant to VE which seeks to improve things through innovation; the allocation of scarce resources is primarily an economic decision (e.g. engineering solutions) which is later considered on moral grounds (e.g. management solutions). Let us explain this anchoring problem.

Paired Comparison

			B	C	D	Description	Score	Percent		
FACTOR	A	A1	C1	D3		Capex	1	8	A	
		B	B1	D3		Opex	1	8	B	
			C	D3		Schedule	1	8	C	
						Risk of Accident	9	76	D	
							Total	<u>12</u>	<u>100</u>	

1. Slight
2. Moderate
3. Major

Figure 1. Which is most Important?

THE NEED TO ANCHOR IN IMPROVEMENT

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When we set about determining where the emphasis for practical ingenuity should be placed we must be conscious that the purpose of VE is to find better ways of doing things. The Paired Comparison specifies strategic values we are to aim for. Of all the things we could improve, Paired Comparison should show us the ones that matter to customers. Central to VE is the outcome that is an improvement on what existed before a VE study was undertaken. To achieve 'improvement' we must define what is meant by it in a particular case. Once we understand what 'improvement' specifically means then this anchors our search for greater value. If we believe a project will be late then that will anchor our minds in the search for ideas that will improve Schedule. In the previous section we asked which was more important between Capex, Opex, Schedule and Risk of Accident. We did not discuss anchoring statements and so many readers will have reverted to ethical values as that's what 'moral' people tend to do. But we are arguing VE is about innovation that leads to improvement and in so doing link the Pre-Event, along with the techniques within it, to the remainder of the VE Job Plan.

PROVING "WHAT IS IMPORTANT?" IS THE WRONG QUESTION

If we accept that VE leads to more value and look at the attributes again in table one and two, we can see that the client is unwilling to degrade "Risk of Accidents" and has set the target at zero percent. This target cannot be improved upon and yet the Paired Comparison in figure one shows it has the highest weighting. If VE is about improvement and "Risk of Accidents" cannot be improved then it should not have the highest weighting; it offers no opportunity to improve the Base Case. What is wrong then? It is the question and the line of thinking that talks of 'importance' rather than 'improvement'. With that realisation we can now see an improvement advantage can only be achieved by improving Capex, Opex or Schedule. So in VE "Risk of Accident" in this case study has no range and therefore is not really an attribute that can be degraded nor improved. As such it is a constraint, or 'given', we have adapted to prove the question, "which is more important?" is the wrong one for Paired Comparison in the context of VE.

The important point here is that the technique of Paired Comparison must be undertaken in relation to other techniques in the Pre-event. Furthermore, the conversations must be anchored in 'improvement'. If the goal is to maximise value then the anchoring in what does 'maximise value' mean should start a line of thinking that makes VE more powerful.

HOW SHOULD PAIRED COMPARISON BE DONE?

The way Paired Comparison should be undertaken is to conduct a strategic review of the role the project, product or service could play. The contribution (i.e. value) of the project, product or service must be understood in the context of the strategic ambitions of the customer. Before asking which attribute offers the greatest chance of value improvement the team should be anchored in what 'improvement' means in 'the' particular VE study. As customers control revenue their value judgements should reign as our profitability (e.g. manufacturer) is inextricably linked to cash-inflows customer control. The firm's desire for profitability must exist within the value created (i.e. the difference between price paid and cost of sale). We should also bring in benchmarking data that helps to stretch the VE team's view of where current limits to performance reside. Furthermore, any systemic links between attributes should be discussed so that trade-offs are understood. Following

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such a rich conversation the customer and VE team are in an informed position to discuss where priorities should be placed so that ingenuity is directed towards significant and sustainable value improvement and profitability.

CONCLUSION

Paired Comparison is but one technique in a causal dependency amongst a number of other techniques. They are bound together in a framework called the Job Plan. Collectively they enable complex team based ingenuity and customer expectations to be aligned. Individually, each stage in the Job Plan and the techniques within it, direct subsequent thinking and innovation. To discuss Paired Comparison in a detached way outside the guiding framework of the Job Plan misses the point. This guiding framework should always aim at value maximisation. To detach the logic and treat techniques as standalone algorithms is like talking about how one side of Velcro lacks any 'stickability'. To ask the question "Which is most important?" in Paired Comparison is to ask the wrong question based on a detached logic that ignores the systemic rationale of VE. This systemic logic is about improving things from what they were to what they could be and where customers define 'improvement.'

Finally the function of Paired Comparison is about '*Communicate Priority*' and that is also the privilege of the customer(s) as they control revenue. This is a function that requires VE teams to see themselves as learning rather than advocating solutions; this 'learning' attitude also forms the basis on mentoring which we believe is the best way of developing a VE capability. They must involve customers in the definition of success a VE team is to aim at. The time has come to explicitly bring client-side innovation into the VE process by way of involving more customers in the Pre-Event processes. This is with a particular need to allow customers to define what they 'value'. It establishes key anchor points from which an innovation process sets off to achieve real improvement. To maximise value the team has to understand what 'Value' means in a particular context and how a combination of techniques will help them achieve it.

To consider techniques outside the guiding framework of the VE Job Plan is to misunderstand why they are there and how they collectively increase value.

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