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# The Value of Value Engineering

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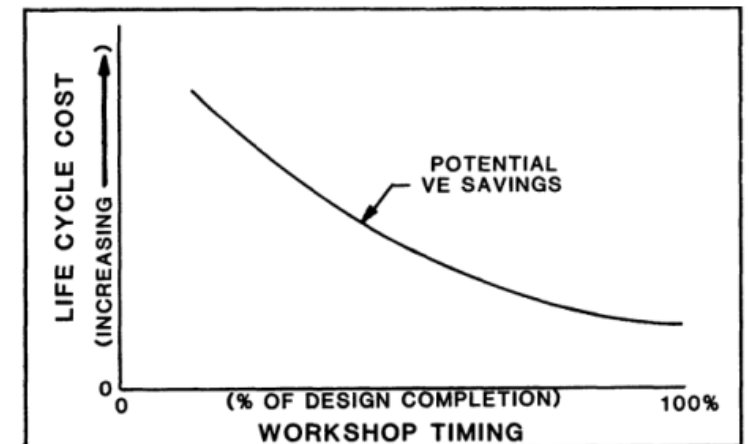
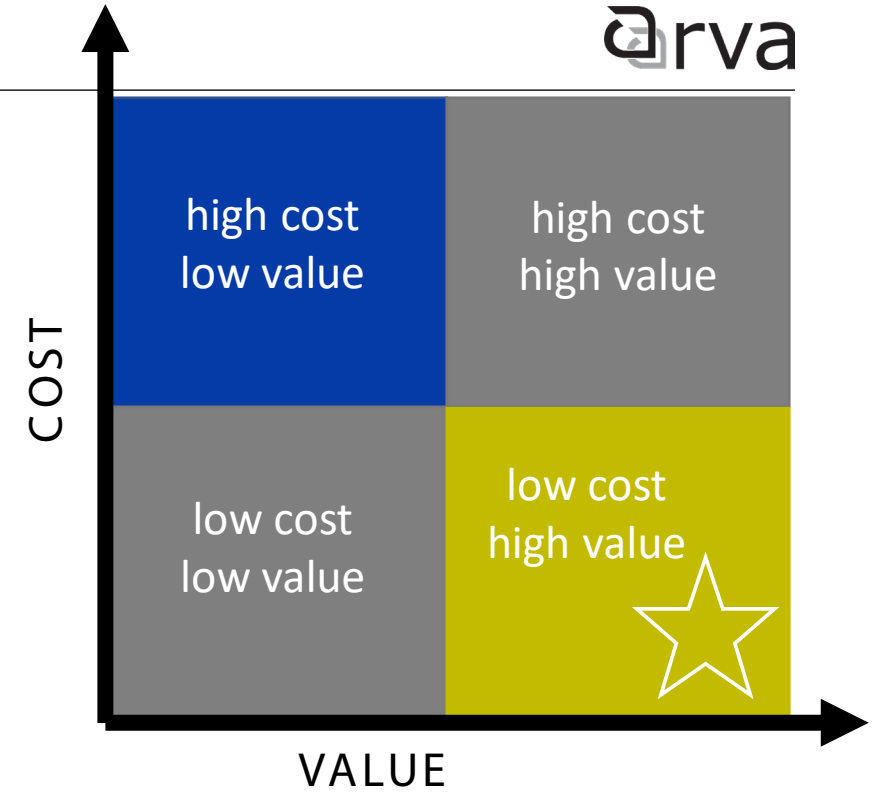


- › Methodology developed by Lawrence Miles, at General Electric Company during WWII
  - War caused shortages of materials and certain finished products
  - But manufacturing still trying to run at max capacity
  - If unable to obtain one material, needed a replacement which performed the same function
- › Systematic team approach to analyze and improve value in a product, facility, system or service
- › North America – “Value Engineering”; Europe - “Value Management”

# WHY CONSIDER VALUE ENGINEERING?



- › Confidence
- › Goal is Value Improvement
  - Scope definition
  - Functional design
  - Constructability
  - Schedule
  - Quality
  - Life Cycle / Maintenance
  - Cost - Not just cost reduction!
- › Earlier the better
  - Before major decisions have been completely incorporated into design
  - Least impact on schedule
  - Lowest cost to implement changes (no re-design)



Project Lifecycle Cost vs Workshop timing [6]


› Informal, QA style reviews by experienced individuals

- Group of highly experienced engineers, operators, and construction professionals to review the project at various stages of design development
- Should be done on every project!
- Similar to Quality Assurance review

› Peer Review

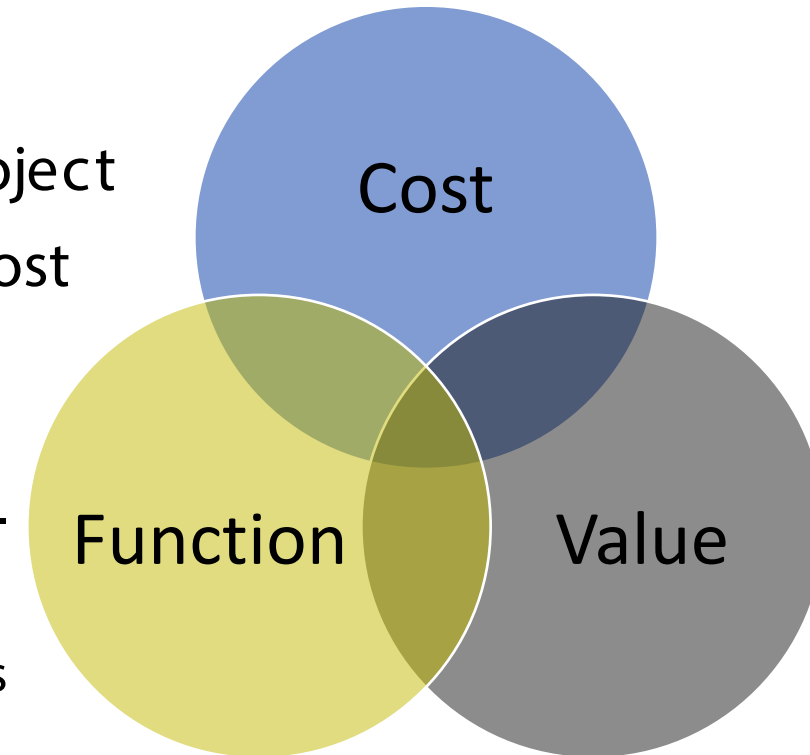
- Outside consultant for a “second look” or value improvements

› Formalized Value Management systematic process



Typically focused on straightforward cost-cutting, as opposed to a blend of cost reduction and improvement of operation and reliability

- › Systematic and structured method or process by a multidiscipline team of persons not involved in the project
- › Examine the function of each item and its associated cost
- › Goal to achieve optimum balance between function, performance, quality, safety and cost
  - Proper balance results in the maximum value for the project.
- › Commonly used value techniques:
  - Value Management (VM) - The full range of value techniques available
  - Value Planning (VP) - Value techniques applied during the planning phase
  - Value Engineering (VE) - Value techniques applied during the design or phase
  - Value Analysis (VA) - Value techniques applied retrospectively to completed projects to analyze or audit the project's performance



## Informal Value Engineering

- › All projects
- › Similar to Risk or Quality Review

## Peer Review

- › Quality or approach concerns
- › Second opinion
- › Targeted goal (reduce cost, improve constructability, etc)

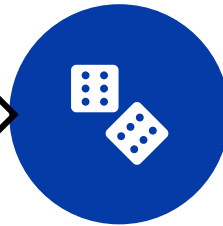
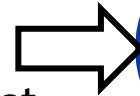
## Value Methodology

- › High Risk projects
- › High-cost / high-priority projects
- › Complex or challenging projects
- › Extensive environmental or geotechnical requirements
- › Projects that substantially exceed their initial cost estimates
- › Projects with "scope creep"
- › Multiple stakeholders
- › Higher level planning studies



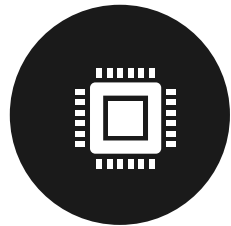
## 1. Investigation

Introduce VE Team to the project



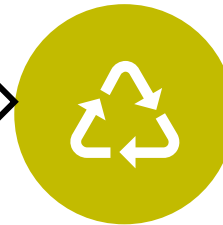
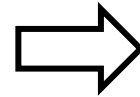
## 2. Function Analysis

Identify high risk and cost elements, understand core function of these elements, assess their worth, cost, performance and quality



## 3. Creative

Brainstorm to identify viable alternatives to achieve the required functions



## 4. Evaluation

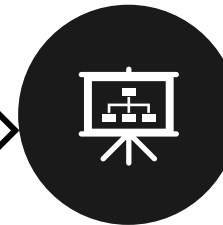
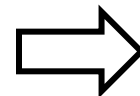
Evaluate the best and lowest life-cycle cost alternatives.

Goal to achieve blend of performance, cost and schedule



## 5. Development

Developing alternatives with sketches, cost estimates, other technical work



## 6. Presentation

Report of VE recommendations for review, approval, reporting and implementation

# NEWCASTLE WSP CASE STUDY – VALUE PLANNING



## Case Study: Newcastle WSP – Value Planning

- › Aging WTP facility with little redundancy and challenges responding to changes in water quality needed to be expanded to service growth in the community
- › First step in the project was to determine which treatment process to use
- › RVA prepared a Technical Memorandum outlining:
  - Existing conditions
  - Water quality
  - Design objectives
  - Alternatives complete with and understanding of their comparative footprint and life cycle costs.
- › 2-day workshop with Engineering, Management, and Operations staff

Treatment Processes	Dissolved Air Flotation (DAF) - Prepackaged	Dissolved Air Flotation (DAF) - In-Basin	Conventional Pre-treatment	Membrane Filtration	Dual Media Filtration	CL2 & CCT for Disinfection	UV Treatment for Disinfection	GAC Caps (Future)	AOP (Future)	Total Cost (Million)
1A			\$9.80		\$4.00	\$2.50		\$1.10		\$17.40
1B			\$9.80		\$4.00		\$1.80	\$1.10		\$16.70
2	\$7.10				\$4.00	\$2.50		\$1.10		\$14.70
3	\$7.10				\$4.00		\$1.80	\$1.10		\$14.00
4	\$7.10				\$4.00		\$1.80		\$3.10	\$16.00
5	\$7.10			\$7.30			\$1.80		\$3.10	\$19.30
6		\$6.50			\$4.00	\$2.50		\$1.10		\$14.10
7		\$6.50			\$4.00		\$1.80	\$1.10		\$13.40
8		\$6.50			\$4.00		\$1.80		\$3.10	\$15.40
9		\$6.50		\$7.30			\$1.80		\$3.10	\$18.70

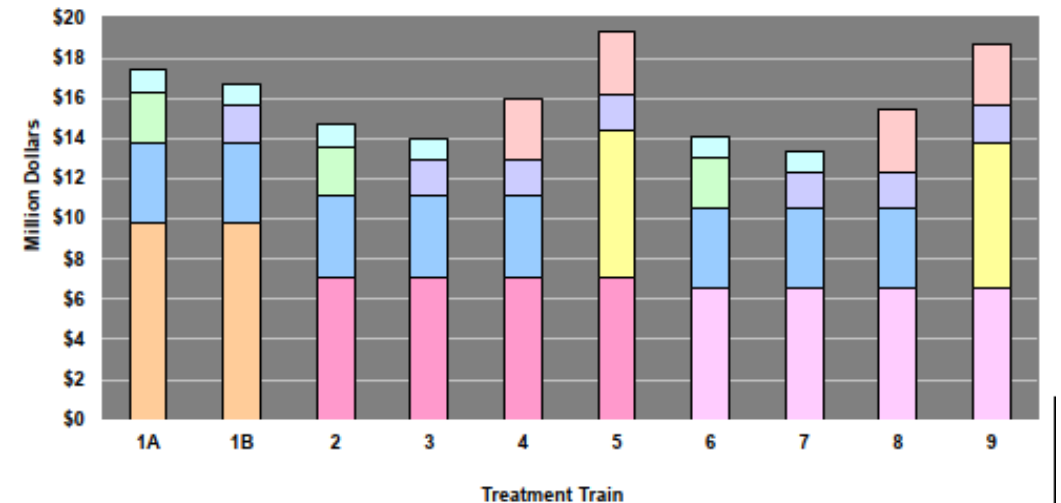


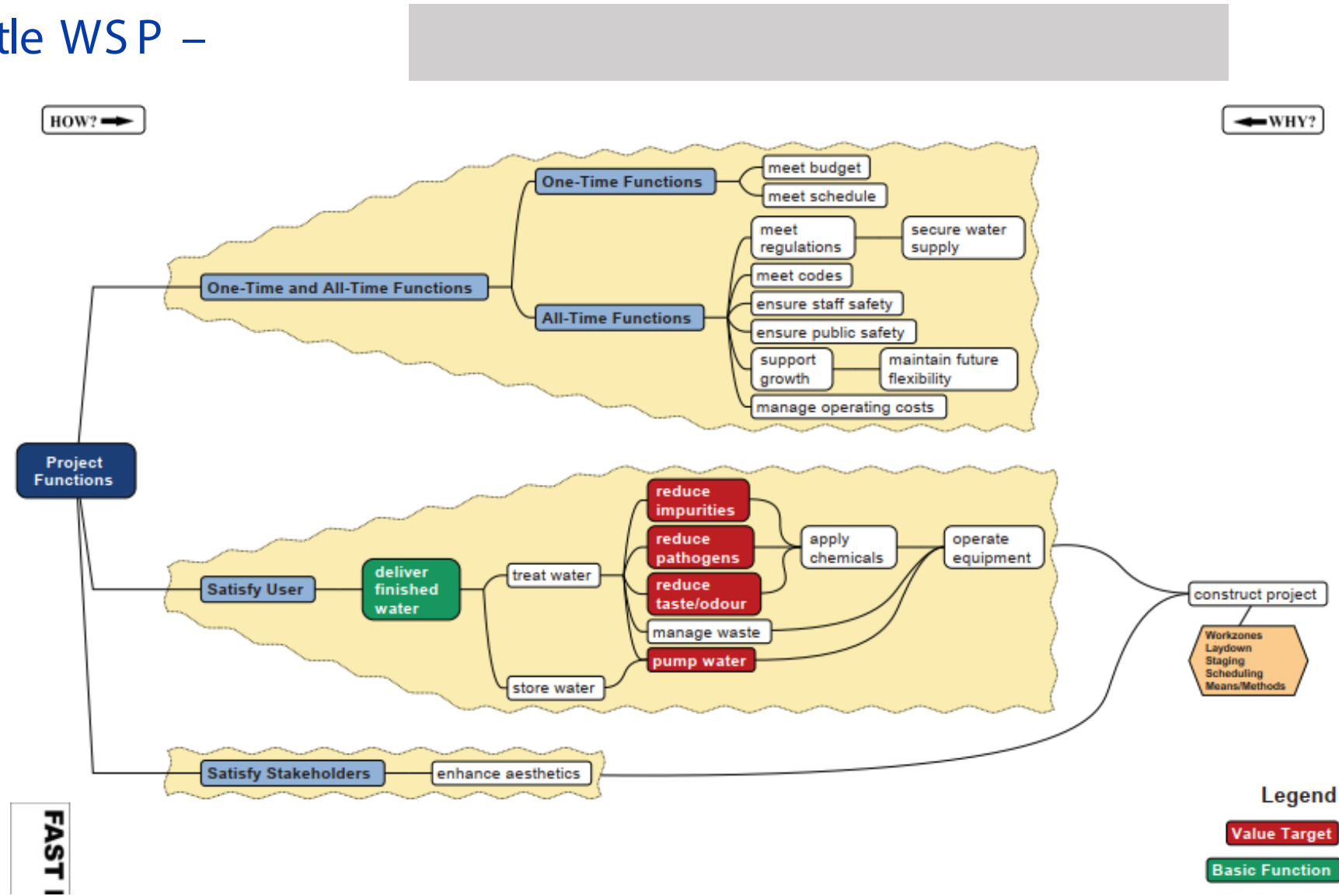
Figure 4.1 - Total cost of treatment alternatives.



# VALUE PLANNING – FUNCTION ANALYSIS

## Case Study: Newcastle WSP – Value Planning

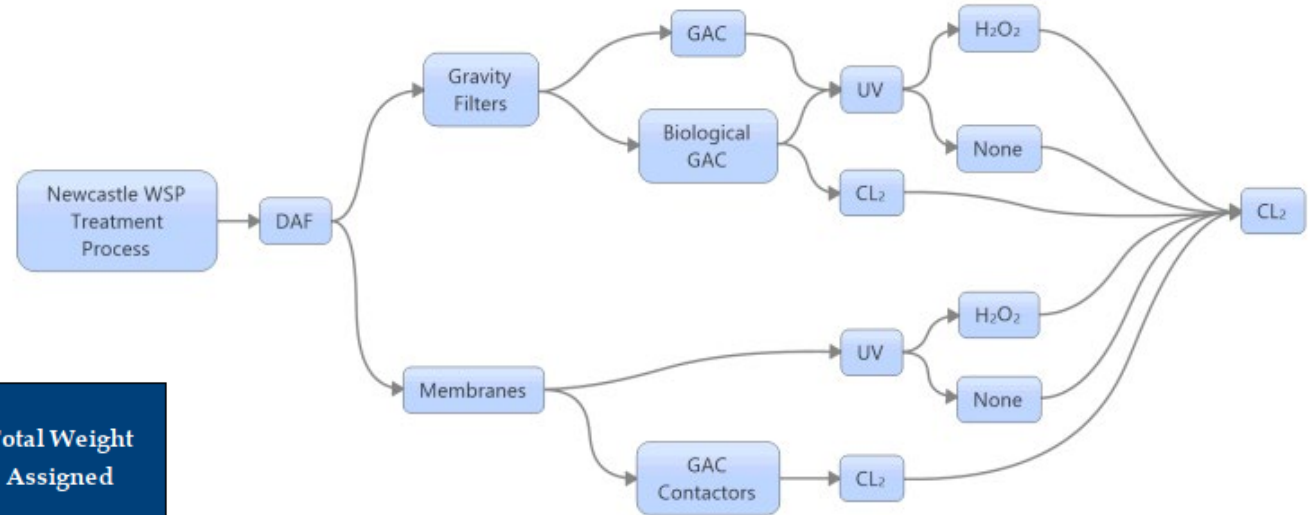
- Core functions of the project were to:
  - Manage water quality
  - Operation and maintenance
  - Ensure future flexibility



# VALUE PLANNING – CREATIVE AND EVALUATION

## Case Study: Newcastle WSP – Value Planning

- › Iterative creativity (brainstorming) / evaluation session to explore water treatment process alternatives



- › Each participant had a say in what the weighting of the core functions in the evaluation

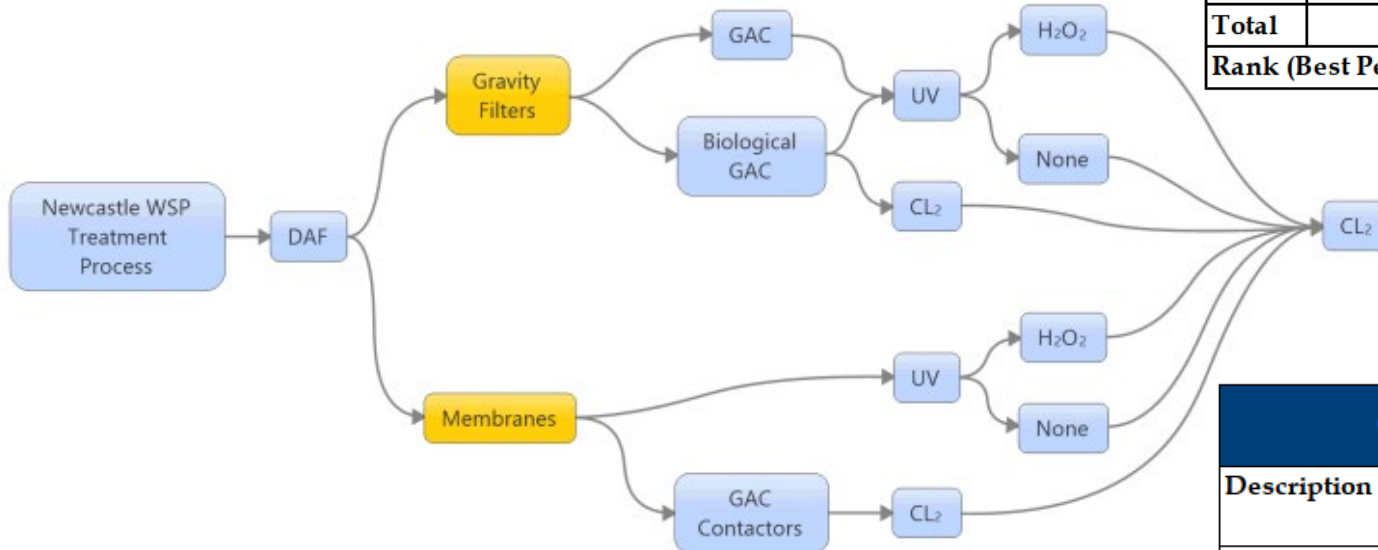
Team Member	Key Functional Performance Attributes			Total Weight Assigned
	Manage Water Quality	Operate/Maintain Plant	Ensure Future Flexibility	
1	20	40	40	100
2	5	55	40	100
3	20	50	30	100
4	40	40	20	100
5	15	40	45	100
6	20	55	25	100
7	70	20	10	100
8	50	30	20	100
9	33	33	34	100
10	20	40	40	100
11	20	60	20	100
12	35	35	30	100
13	10	60	30	100
<b>Total</b>	<b>358</b>	<b>558</b>	<b>384</b>	<b>1300</b>
<b>Weight (Norm)*</b>	<b>28</b>	<b>43</b>	<b>29</b>	<b>100</b>

# VALUE PLANNING – EVALUATION AND REPORTING



## Case Study: Newcastle WSP – Value Planning

- Each level of treatment was evaluated by the group to arrive at the preferred treatment train



Functional Performance Attributes/Alternatives			Baseline (Alt. B)		Alt. C	
Description			Dual Media Gravity Filters		Membrane Filters	
	Criteria	Wt.	Score	Total	Score	Total
1	Manage Water Quality	28	5	140	6	168
2	Operate/Maintain Plant	43	5	215	2	86
3	Ensure Future Flexibility	29	5	145	7	203
Total		100		500		457
Rank (Best Performance = 1)				1		2

Cost Components/Alternatives	Baseline (Alt. B)	Alt. C
Description	Dual Media Gravity Filters	Membrane Filters
Performance	500	457
Total Life Cycle Cost	\$4,000,000	\$7,300,000
Value Ratio V ~ P/C	125.00	62.60
Value Improvement (over Baseline)	0%	-50%
Rank (Most Preferred = 1)	1	2

## Case Study: Newcastle WSP – Value Engineering

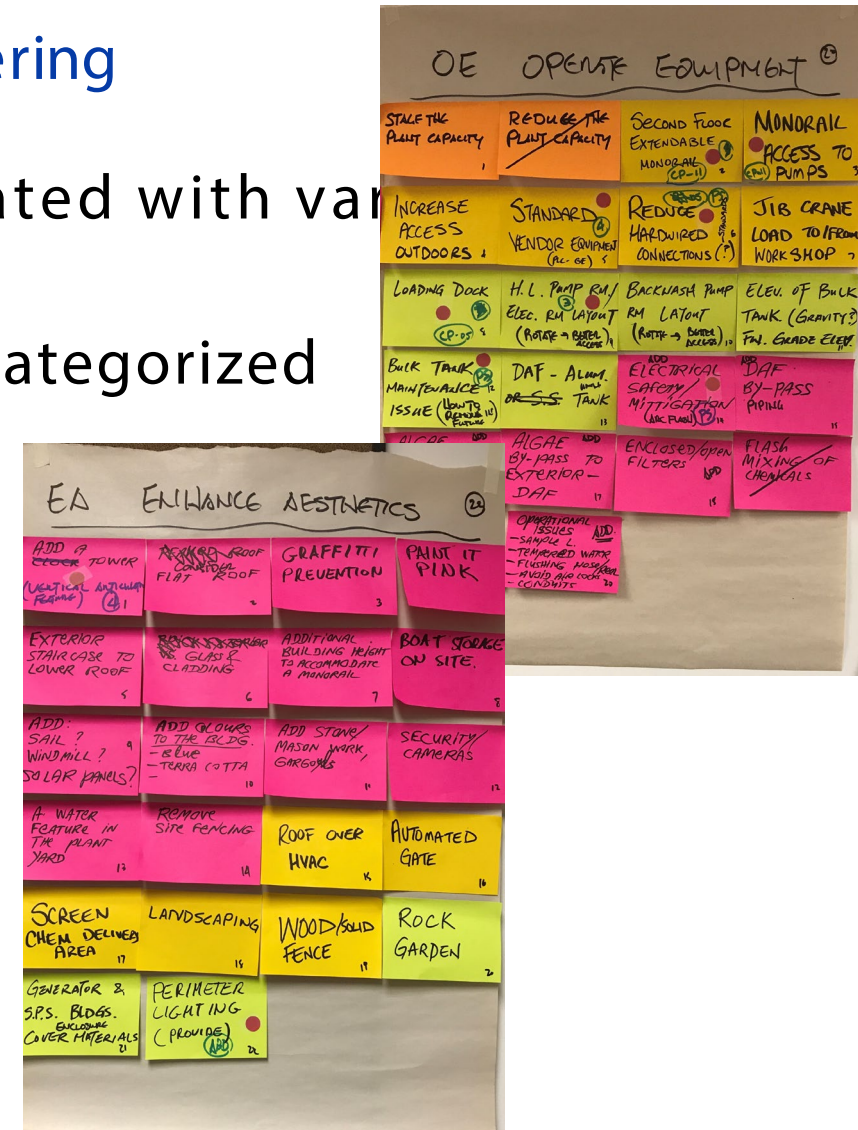
- › 30% Design was then prepared
- › 2-day engineering workshop was held with Management, Engineering and Operations staff
- › Purpose of the VE study was to:
  - Review design developed to date
  - Identify opportunities to improve design, procurement, constructability and operations
  - Identify opportunities to add value to the proposed strategy
  - Develop and/or refine concepts or components to improve performance and/or avoid cost while maintaining design standards, codes, safety, and reliability

# VALUE ENGINEERING – COST AND FUNCTION



## Case Study: Newcastle WSP – Value Engineering

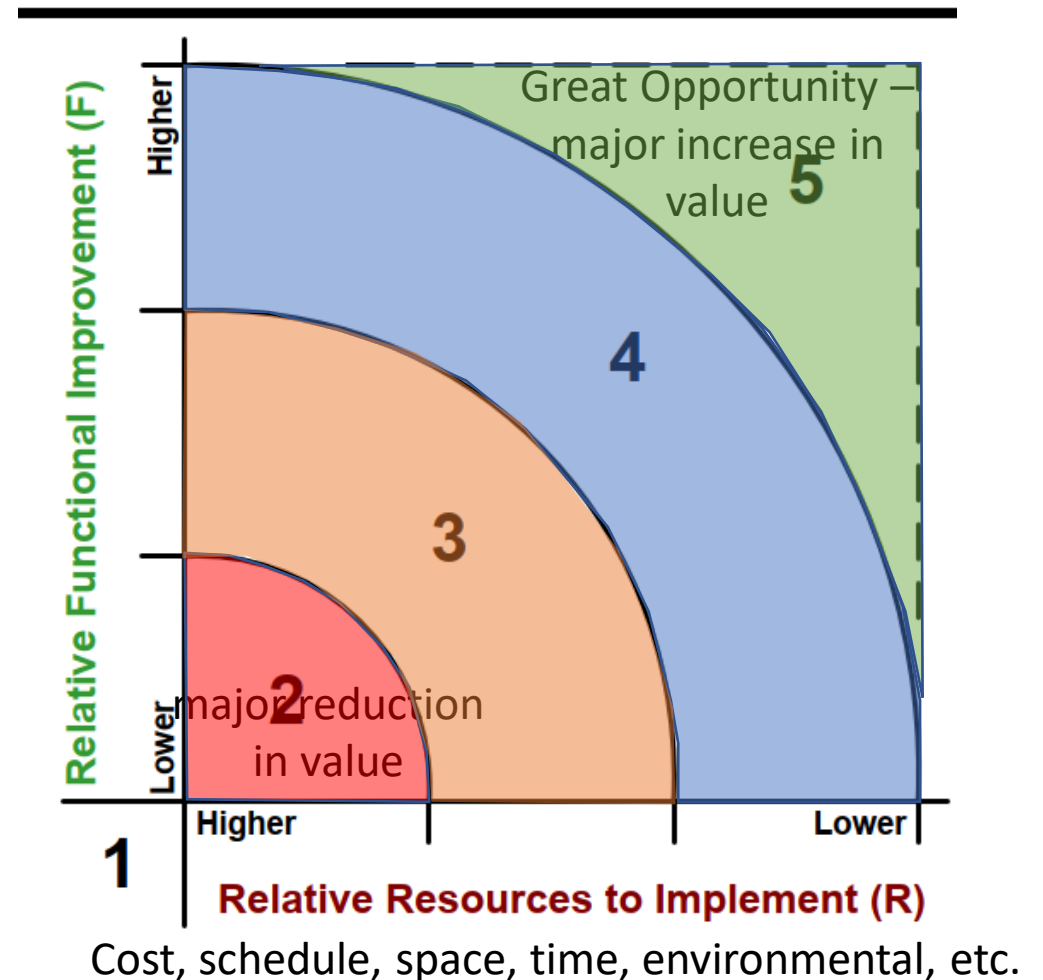
- › Cost model to understand costs associated with various project components
- › Functions of project were identified and categorized
  - Essential; secondary; and supporting
- › Several functions identified as value targets
  - Construct project
  - Enhance aesthetics
  - Maintain future flexibility
  - Operate equipment
  - Pump water
  - Store water
  - Treat water



## Case Study: Newcastle WSP – Value Engineering

- › Brainstormed 107 ideas to improve the project value
- › Ideas were organized by Value Target and rated
- › Ideas rated higher than 4 were carried forward as shortlist of VE ideas
- › Shortlist was developed in further detail
  - Cost/savings
  - Advantages/disadvantages

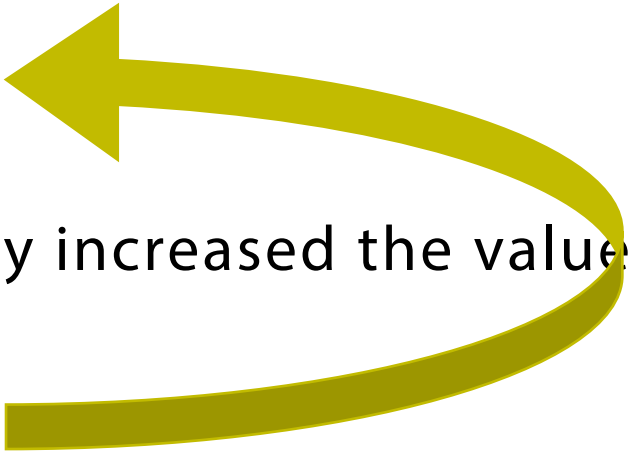
$$\text{Value} \sim \frac{\text{Function}}{\text{Resources}^*}$$



## Case Study: Newcastle WSP – Value Engineering

- › Revised layout:
  - Relocated chemical rooms
  - Moved electrical room to location with better outside access and made larger
  - Condensed all pumps into one central pump room, raise the ceiling to accommodate bridge crane
  - Improved access to tanks
- › Raised the building to provide additional flood protection
- › Raised clearwell floor to save construction cost while maintaining required storage volume
- › Improved aesthetic design of plant

## Case Study: Newcastle WSP – Value Engineering

- › Stakeholder engagement and buy-in
    - Stakeholders stuck in a room together for 4 days with no phones!
  - › Decisions were made as a team
    - Reduction in design changes further on in design
    - Better control on engineering fees and less re-work
  - › Cost savings were identified, but only carried if they increased the value of the project
  - › Cost of the VE session Approx \$100k
    - Value engineering consultant, design engineering consultant, 4 days each for 8 Region staff (Management, Engineering, Operations)
  - › Construction cost - \$50M
  - › <0.5% of construction cost
- 



# SUMMARY

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- › Informal Value Engineering and Peer Reviews can save costs and add value to a project.
  - Important to have a well defined objective for the reviews
- › Value Management can offer additional benefits to major projects
  - Brings stakeholders together and engages them in the design development
  - Reduces design changes, rework and additional engineering fees and time
  - Improves the value of the end product
  - Can achieve cost savings or justify costs
  - Encourages creativity
- › Provide confidence that the project will achieve the desired objectives
- › Typically a small fraction of the capital cost

