LCCP in Water Facilities

The Pouderoyen Water Rehabilitation Project

Case Hystory

by

CIS ECOLOGIA

THE PROJECT PWRP

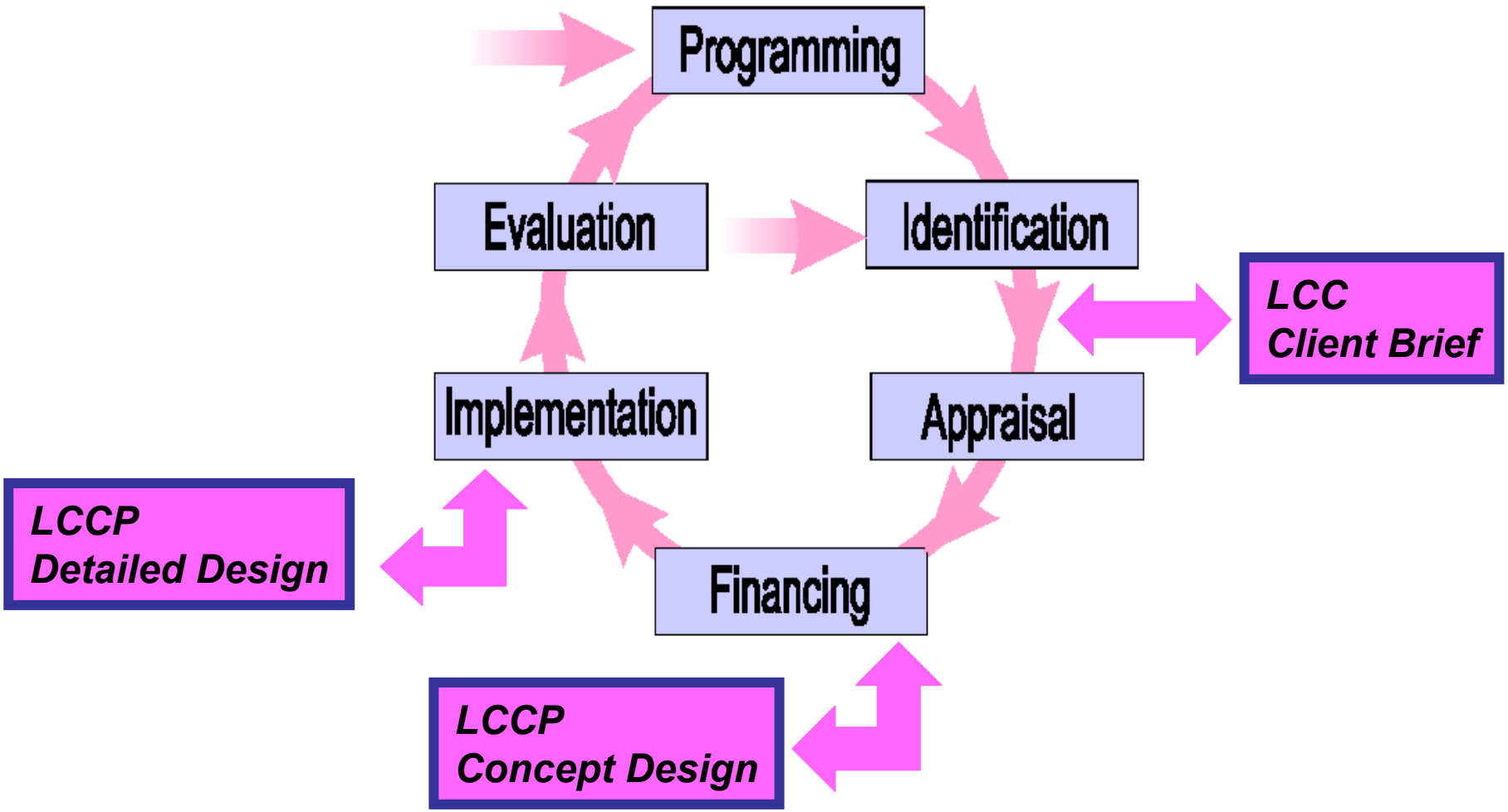
- Financing: EU - EDF
- Value: 6.5 m€
- water treatment and distribution: 6.000 cu.m/d
- Population served : 25,000 ab.
- Client : Guyana Water Authority, now (GWI)
- Contractor: CIS ECOLOGIA -Italy
- Preliminary design: Garland Ormond - Ireland
- Supervision: Vikab – Guyana
- Works duration 24 months

Pouderoyen treatment unit

booster pumps

Backwash and air blowers

LCCP Model in the Project Cycle



Strategic Level

- LCC1 (client brief)
- Total cost (EPV) of the utility during its life span:
  - Design,
  - Finance,
  - Build,
  - Operate,
  - Maintain,
  - Environmental asses…….
  - Decommissioning….

Identification of the major class of cost originated by the project and ranking of the same in terms of % of the:

investment cost ;

LLC (PV)

Client Brief – preliminary data input

WWTP - CLIENT BRIEF - DATA LOG

Water Treatment Plant

1

LCC CALC

ENV

click for E
module

	INPUT			
			MIN.	MAX.
1	expected operating life	years	30	40
2	population served (actual)	n.	20.000	30.000
3	population served (in 10-20 yrs)	n.	30.000	40.000
4	*population density*	select	low	low
5	*industrialisation level*	select	low	low
6	*morphological context*	select	flat	flat
7	*row water source*	select	underground	underground
8	*reticulation needed ?*	yes/no	no	no
9	*land available ?*	yes/no	yes	yes
10	*site infrastructure available ?*	yes/no	no	no
11	standard water consumption (per capita)	cu.m./ab.d	0,1	0,2

Project:	*Pouderoyen Water Rehabilitation*			Envronmental Impact Assessment needed?
Phase:	Client Brief Level	Yes/No		Directive 11/ 97/ CE click for screening guidance
	Concept Design	Yes/No		
	Detailed Design Level	Yes		EIA GUIDELINES SCREENING
Completed by:	*CIS ECOLOGIA srl*			
Date: March 2004	*10-mar-04*			

Service life (years) 50	Phase	Weights (%)	Environmental impacts	Weights (%)	Parameter	Weights (%)	Yes: 1 Partly: 0.5 No: 0	Points
Period of analysis (years) 50								
Environment	**Design / Construction**	15	**Site**	33	view impact mitigation	50	0,0	0,0
					noise / odor mitigation	50	1,0	2,5
			Sum			100		*2,5*
			Process / materials	33	Water Treatment process	50	0,5	1,3
					Sludge Treatment process	0	0,0	0,0
					Electro-mechanical Efficiency	25	0,5	0,6
					Env. Declaration or label	0	0,0	0,0
					Gravity flow design	25	1,0	1,3
			Sum			100		*3,1*
			Waste	33	Material management	50	0,0	0,0
					Waste reduction	50	0,5	1,3
			Sum			100		*1,3*
	Sum Construction			100				***6,9***
	Operating & Maintenance	80	**Energy**	25	High efficiency equipment	17	0,5	1,7
					Monitoring and control	17	0,5	1,7
					Solar cells	17	0,0	0,0
					Remote control equipment	17	0,5	1,7
					Service Buildings	17	1,0	3,3
					back wash efficiency	17	0,5	1,7
			Sum			100		*10,0*
			Materials / Consumables	25	Chemicals Dosing	33	0,0	0,0
					Env. Sound maintenance	33	1,0	6,7
					Replacement frequency	33	0,5	3,3
			Sum			100		*10,0*
			Row Water	25	Row water control	50	0,0	0,0
					Backwash	50	0,0	0,0
			Sum			100		*0,0*
			Treated Water	25	Effluent Water Control	50	0,5	5,0
					Water Storage	50	1,0	10,0
			Sum			100		*15,0*
	Sum Operating & Maintenance			100				***35,0***
	Disposal & Residual Value	5	**Disposal**	100	Design - sorting and reuse	33	0,5	0,8
					Materials - sorting and reuse	33	0,5	0,8
					Residual value environmentally	33	0,5	0,8
			Sum			100		*2,5*
	Sum Disposal & Residual Value			100				***2,5***
Scoring Envrionment		*100*						*44,4*

It continues in the next page.

Occupation	**Operating & Maintenance**	100	**Air quality and temp.**	33	Adjustable temperature	33	0,5	5,6
	(Service Buildings)				Harmful fumes	33	1,0	11,1
					Ventilation	33	0,5	5,6
			Sum			100		*22,2*
			Daylight and lighting	33	Daylight	50	1,0	16,7
					Sunlight protection	50	0,5	8,3
			Sum			100		*25,0*
			Indoor noise	33	Design	50	0,0	0,0
					Materials and components	50	0,0	0,0
			Sum			100		*0,0*
	Sum Occupation			100				***47,2***
Scoring Occupation		***100***						***47,2***
Mobility	**Operating & Maintenance**	100	**Transport**	100	Public transport	20	0,5	10,0
					Usage of public tr.; staff	20	0,5	10,0
					Transport distance; staff	20	0,5	10,0
					Access road	20	1,0	20,0
					Usage of public tr.; customers	20	0,5	10,0
			Sum			100		*60,0*
	Sum Mobility			100				***60,0***
Scoring Mobility		***100***						***60,0***
Society	**Construction and Operating and Maintenance**	100	**Location**	50	Historic sites	0		0,0
					Infrastructure	50	0,5	12,5
					Manpower	50	0,5	12,5
			Sum			100		*25,0*
			Regional development	50	Impact on surroundings	33	1,0	16,7
					Reliability of supply	33	1,0	16,7
					Urban development	33	1,0	16,7
			Sum			100		*50,0*
	Sum Society			100				***75,0***
Scoring Society		***100***						***75,0***
Total Assessment						Weights %		
Scoring Environment						30	44	13,3
Scoring Occupation						40	47	18,9
Scoring Mobility						15	60	9,0
Scoring Society						15	75	11,3
			Sum			100		*52,5*
Total Scoring	***Scoring <50=Poor, 50-60=Average, 60-70=Satisfactory, 70-80=Good, 80-90=Very Good, >90=Excellent***					**AVERAGE**		**52,5**

The score is registered in the logbook?

LIFE CYCLE COST PERFORMANCE MODEL - CLIENT BRIEF STAGE

Project	**PWRP**					
Study period	**32,5**	**years**				
Construction period	**2**	**years**				
Nominal discount rate	**0,06**					**Own Distribution**
Inflation rate	**Min**	**0,02**	**Max**	**0,06**		
Real discount rate	**0,02**					
Consider revenues	**y**					

LIFE CYCLE COST PERFORMANCE MODEL - CLIENT BRIEF STAGE

		No of units	Cost per unit Min	Cost per unit Max	Cost per unit Most Likely	Expected Present Value	% of LCC	% of Capital Cost
Project Life Cycle Costs						**19.652.077**		
Capital Cost		1	3.600.000	8.000.000	6.000.000	**5.866.667**	**29,85%**	
Facility Management Cost						**13.550.410**	**68,95%**	**230,97%**
- Operation (per year)		1	180.000	400.000	230.000	**5.955.392**	**30,30%**	**101,51%**
- Maintenance (per year)		1	90.000	200.000	125.000	**3.051.219**	**15,53%**	**52,01%**
- Capital Replacement						**2.816.000**	**14,33%**	**48,00%**
PV Percentage on capital cost	n							
Annual Percentage on capital cost	y		0,39	0,60	0,45			
- Other FM costs (per year)		1	*60.000*	*100.000*	*75.000*	**1.727.799**	**8,79%**	**29,45%**
Costs at end of study period			-	-	-	**-**	**0,00%**	**0,00%**
Management costs			180.000	300.000	225.000	**235.000**	**1,20%**	**4,01%**
Overhead costs			-	-	-	**-**	**0,00%**	**0,00%**
Project Cash Flow			**Min**	**Max**	**Most Likely**			
Cash flow in present value			7.265.700	12.916.800	10.000.000	**10.060.833,33**		
Net Present Value						**- 9.591.243,58**		

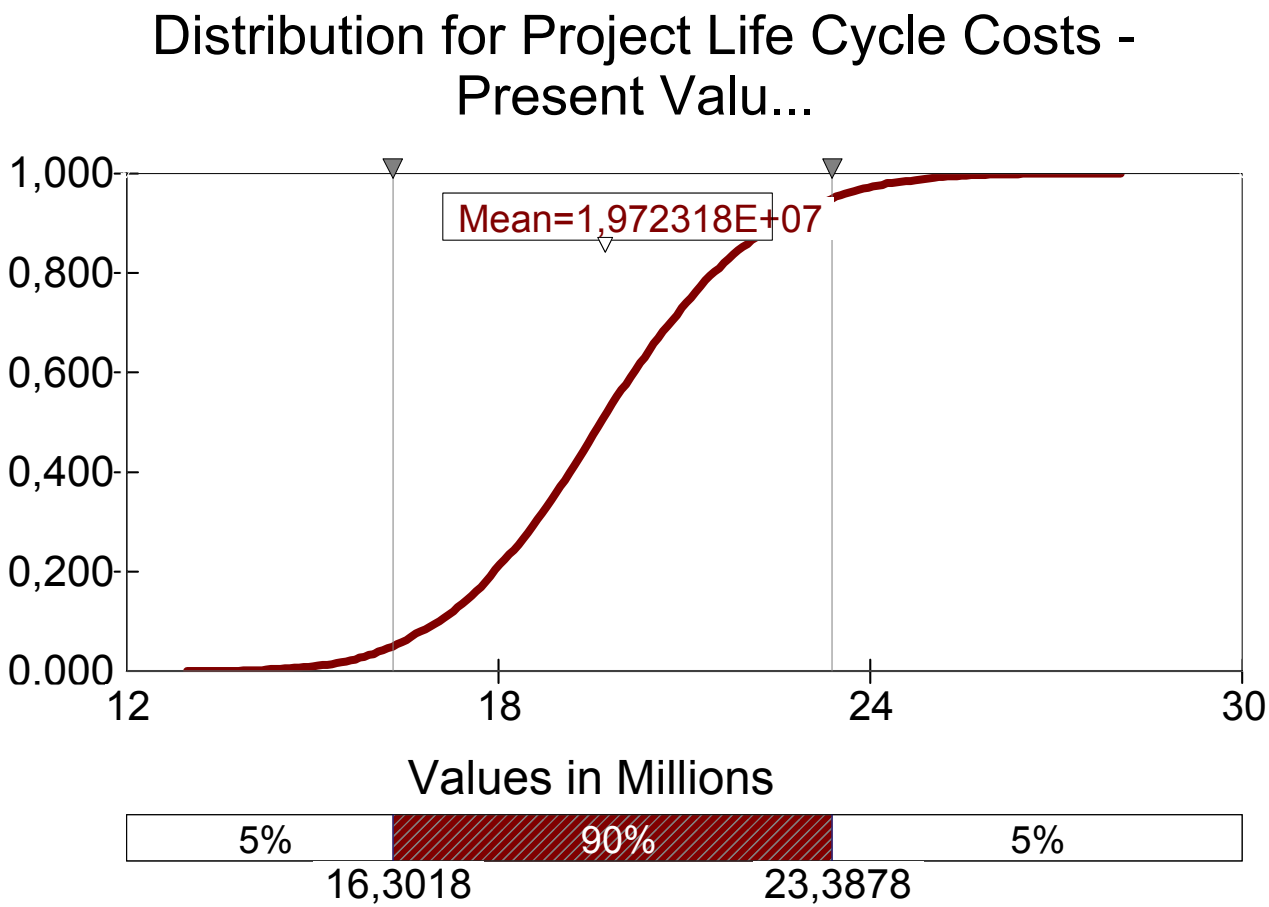
LCC1

- The result of the exercise is:
  - The expected present value(LCC),
  - The % of different operations..

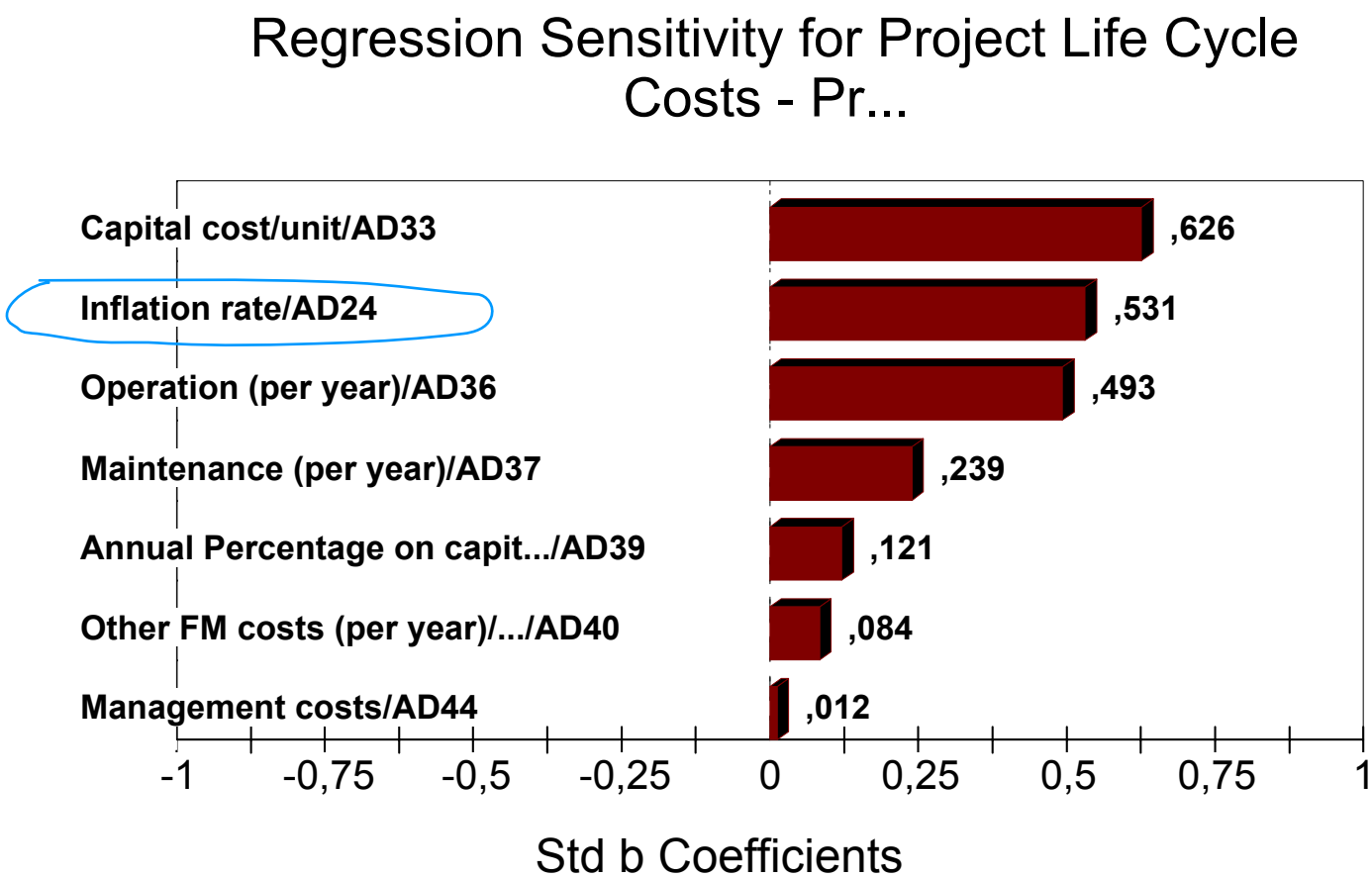
- The LCC value has a number of limits related to the evolution of the economic and financial situation…
- It works better if used to compare alternative solutions….
- The ranking in the component of costs is very usefull to identify on which part of the project's operation are the major costs

Client Brief

(@risk output)



Client Brief (@risk output)



LCC1

- What kind of information and expertise do we need to operate at LCC1 level?
  - Terms of reference (Project identification)
  - Standardised costs
  - General Technical knowledge of the process…..
    - » indication about the lifespan
    - » What Environmental general factors should be considered?

- What kind of info do we expect / provide with our database?
- What kind of Env. Consideration could be introduced?

- It is possible, with the level of info available at CB stage, to compare?
  - » The exercise is limited to the main financial indicators and env. considerations

LCC1

- This is an example of comparison of LCC % at different inflation and discount rates….NOT RELATED to the PWRP case history

Project	waste water treatment plant					Expected Present Value		
Study period	35	years				17.918.194		
Construction period	2	years					% of LCC	% of Capital Cost
Nominal discount rate	0,04				Own Distribution	2.683.333	14,98%	
Inflation rate	Min	0,025	Max	0,045		14.999.860	83,71%	559,00%
Real discount rate	0,00							
Consider revenues	y							

Project	waste water treatment plant					Expected Present Value		
Study period	35	years				14.365.617		
Construction period	2	years					% of LCC	% of Capital Cost
Nominal discount rate	0,05				Own Distribution	2.683.333	18,68%	
Inflation rate	Min	0,02	Max	0,035		11.447.283	79,69%	426,61%
Real discount rate	0,02							
Consider revenues	y							

LCC2 (concept design)

- Comparative evaluation of EPV with respect to alternative technical, solutions

Identification of most of the components for any class of cost originated by the project and ranking of the same in terms of % of :

investment cost ;

WLC (PV)

LCC2

- What kind of information and expertise do we need to operate at this level?
  - More detailed terms of references, including location, client and user carachteristics, etc
    - » We have the general specs of tender docs
  - More technical background and knowledge
  - Cost database linked to the location
    - » Example of cost of manpower

LCC2

- What kind of info do we expect / provide with our database?
  - We propose the costs per class of work
  - It is possible, with the level of info available at Conc.Design stage, to compare? Yes, if...
- what kind of Env. Consideration could be introduced?

LIFE CYCLE COST PERFORMANCE MODEL - CONCEPT DESIGN STAGE

Project	Pouderoyen Water Rehabilitation Project				
Study period	32,5	years			
Construction period	2	years			
Nominal discount rate	0,03				Own distribution
Inflation rate	Min	0,008	Max	0,01	
Real discount rate	2%				
Consider Cash-Flows	y				

LIFE CYCLE COST PERFORMANCE MODEL - CONCEPT DESIGN STAGE

		Cost			Own distribution	Expected Present value
Capital Cost		**Min**	**Max**	**Most Likely**		**5.013.815,05**
Management Costs		340.000	560.000	*480000*		**460.000,00**
Overheads		380.608	418.330	*400000*		**399.646,05**
Design Costs						**131.947,51**
Construction						**3.958.425,23**
Indirect costs/Prelims						359.856,84
- Site Overheads		0,000	0,000	0,000		-
Management		0,040	0,080	*0,050*		203.918,88
Plant		0,010	0,030	*0,020*		71.971,37
Other (transport)		0,020	0,030	*0,020*		83.966,60
Direct costs		**Cost per unit** **Min**	**Max**	**Most Likely**		3.598.568,39
- Supply of Material and equipments		1.615.021	1.795.446	*1.650.000*		1.686.822,36
- Substructure (foundations)		383.670	436.872	*400.000*		406.847,26
- Treatment unit		805.704	1.010.000	*950.000*		921.901,33
- buildings		230.202	243.400	*235.000*		236.200,66
- Erection and Assembling		77.469	193.254	*100.000*		123.574,23
- Services		124.821	156.026	*145.000*		141.948,76
- External Works		51.156	107.665	*85.000*		81.273,78
Commission & Hand Over		**Cost** **Min**	**Max**	**Most Likely**		**63.796,26**
- C & HO Team		50000	60000	55000		52.780,14
- Early Defects						11.016,11
Percentage		0,001	0,0045	0,0032		

from preliminary design

Facility Management Cost		No of units Min	Max	Most Likely	Description of Unit	Own distribution	Cost per unit Min	Max	Most Likely	Own distribution
Operation										
Utilities										
Energy										
Estimated as overall	n									
Estimated from breakdown	y									
- treatment		288000	300000	290000			0,1	0,2	0,15	
- pumping		738720	900000	750000			0,1	0,2	0,15	
- Other							10	30	20	
Personnel										
Estimated as overall	n									
Estimated from breakdown	y									
- Engineer		1	2	1			6000	7200	6150	
- Operator		8	12	10			4000	5000	4250	
- Skilled		10	12	10			3200	4300	3500	
- Other		0	0	0			0	0	0	
PPM										
Estimate as overall	y	1	1	1			90000	200000	125000	
Estimate from breakdown	n									
PV of total Life Cycle Replacement										
Use performance model	n									
PV Percentage on capital cost	n									
Annual Percentage on capital cost	y						0,009	0,015	0,011	
Reactive Maintenance										
PV Percentage on capital cost	n									
Annual Percentage on capital cost	y						0,002	0,01	0,005	
Management, overhead and other										
		Min	Max	Most Likely						
Percentage of total PV Maintenance and replacements		0,15	0,2	0,18						

LIFE CYCLE COST PERFORMANCE MODEL - CONCEPT DESIGN STAGE

				Life Cycle Replacement (yrs)			Own distribution		Frequency of task (yrs)	YEAR 3	YEAR 4
				Min	Max	ML					
Pumps				4	10	6		Input Parameters	7		
Diffusers				5	10	7		Input Parameters	7		
Generators				8	12	10		Input Parameters	10		
Motor Valves				5	12	8	Lognormal	Input Parameters	10		
Services				3	6	5		Input Parameters	5		
External Works				1	10	5		Input Parameters	5		

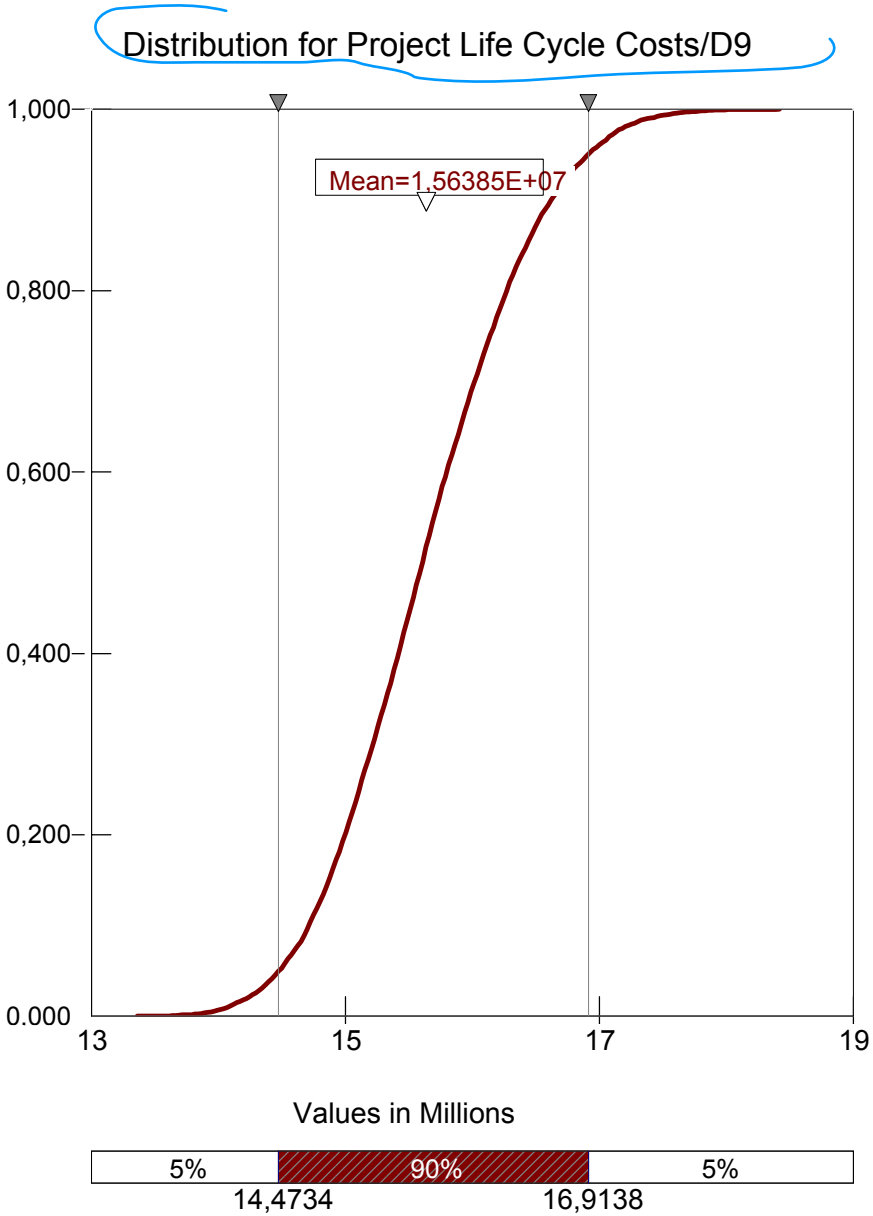
	No of units			Own distribution	Cost per unit at replacement time			Own distribution	Frequency of task (yrs)	YEAR 3	YEAR 4
	Min	Max	ML		Min	Max	ML				
Pumps	8	12	9		4500	7500	5500		7		
Diffusers	4	4	4		12500	19000	15000		7		
Generators	1	2	1		25000	30000	27000		10		
Motor Valves	10	20	18		3000	5000	3800		10		
Services	5	15	12		1500	3500	2000		5		
External Works	20	50	35		3500	12500	9000		5		
Total										0,00	0,00
Present Value										0,00	0,00
Cumulative Present Value										0,00	0,00

connection with the summary in EPV

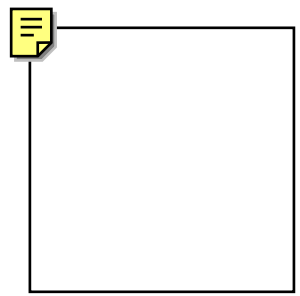
LIFE CYCLE COST PERFORMANCE MODEL - CONCEPT DESIGN STAGE

	Expected Present value totals over study period	% of LLC	% of Capital cost
Project Life Cycle Costs	**15.638.528**		
Capital Cost	**5.013.815,05**	**32,06%**	
- Management Costs	**460.000,00**	**2,94%**	**9,17%**
- Overheads	**399.646,05**	**2,56%**	**7,97%**
- Design Costs	**131.947,51**	**0,84%**	**2,63%**
- Construction	**3.958.425,23**	**25,31%**	**78,95%**
- Commission & Hand Over	**63.796,26**	**0,41%**	**1,27%**
Facility Management Cost	**10.624.713,37**	**67,94%**	**211,91%**
- Operation (per year)	**5.535.264,22**	**35,40%**	**110,40%**
- Maintenance	**2.975.403,72**	**19,03%**	**59,34%**
- Life cycle replacement	**1.556.442,34**	**9,95%**	**31,04%**
- Other FM costs (per year)	**855.890,40**	**5,47%**	**17,07%**
Cash flow	**6.886.312,02**		
Net present value	**- 8.752.216,4**		

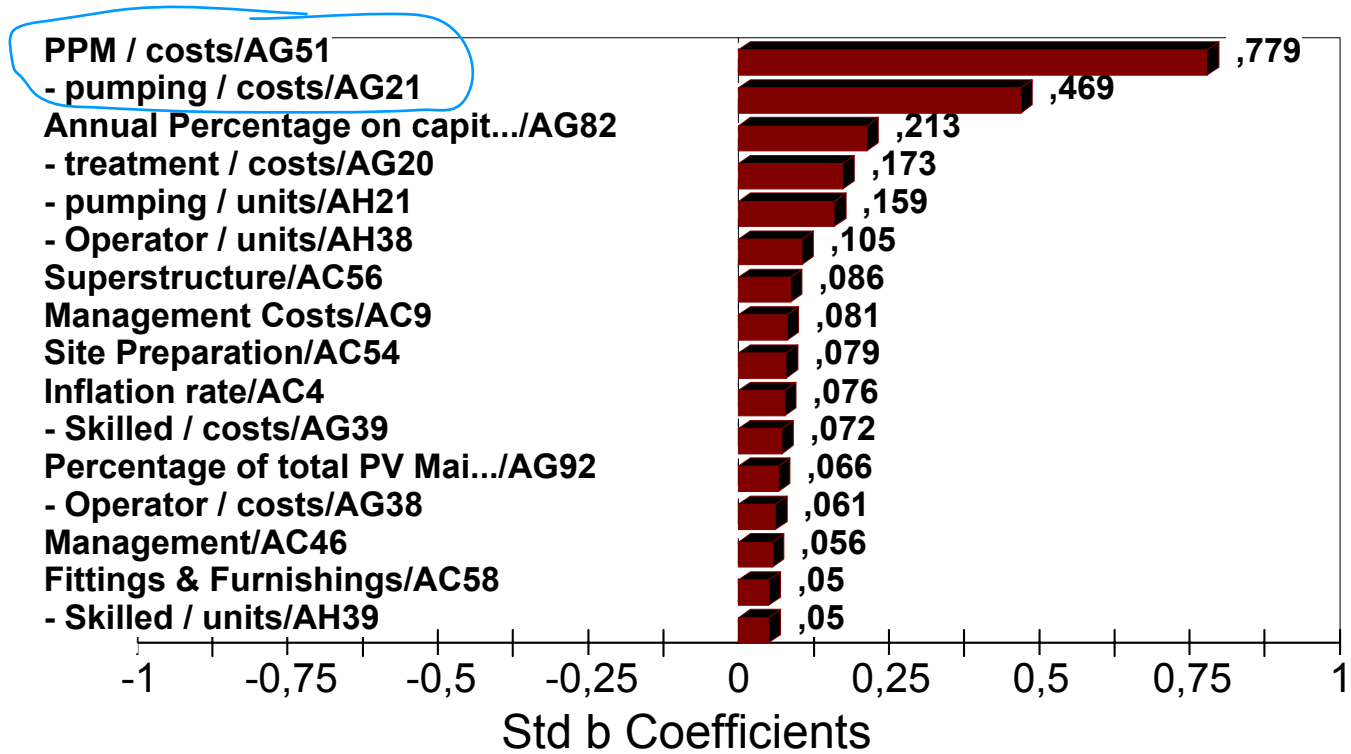
are cashfolw's figures duly actualised?

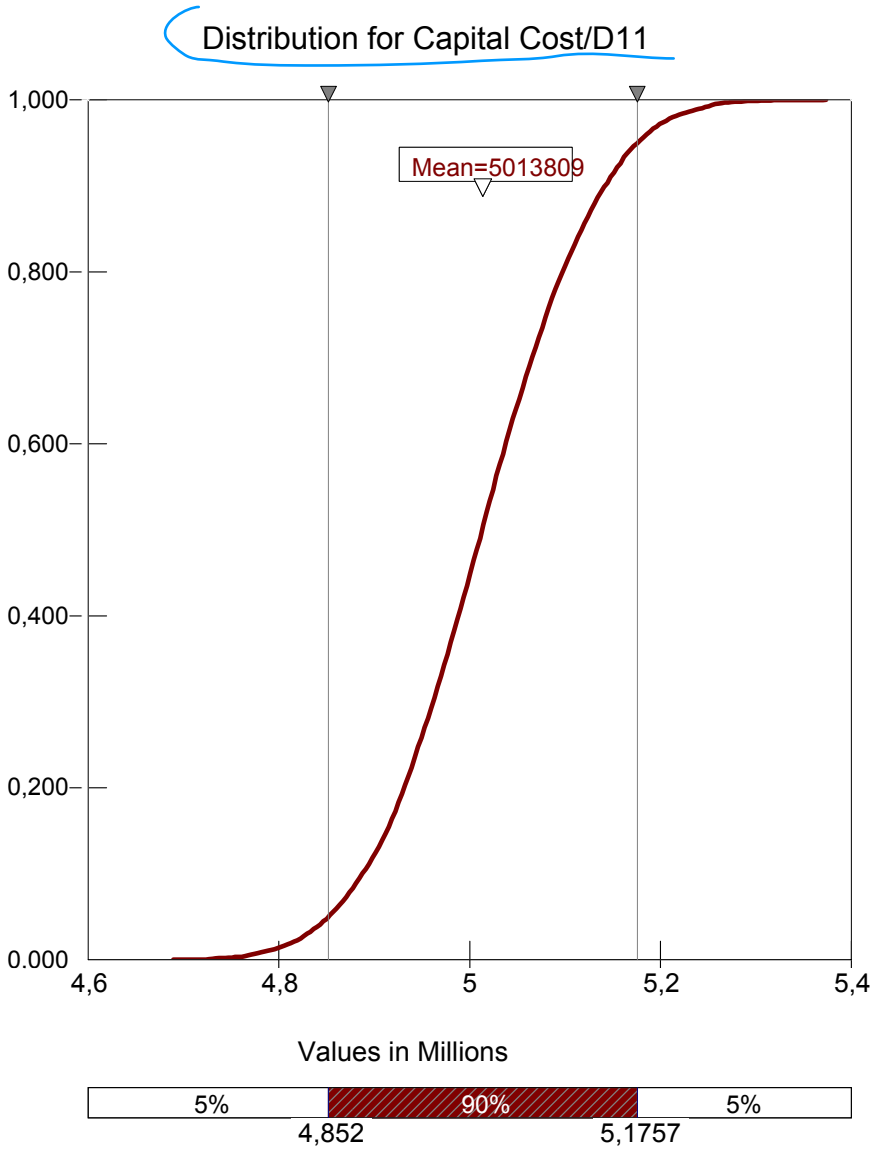


Summary Information	
Workbook Name	s, ELF Conceptdesign V1-7
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1009
Number of Outputs	11
Sampling Type	Latin Hypercube
Simulation Start Time	28/04/2004 18.51
Simulation Stop Time	28/04/2004 18.58
Simulation Duration	00.07.00
Random Seed	1736642627



Regression Sensitivity for Project Life Cycle Costs/D9





Summary Statistics			
Statistic	**Value**	**%tile**	**Value**
Minimum	4.689.246,50	5%	4.851.980,00
Maximum	5.373.767,50	10%	4.887.466,00
Mean	5.013.808,76	15%	4.913.232,00
Std Dev	97.842,62	20%	4.931.129,50
Variance	9573178476	25%	4.946.755,00
Skew ness	0,011994858	30%	4.961.785,00
Kurtosis	2,846413615	35%	4.975.227,50
Median	5.013.160,50	40%	4.988.284,00
Mode	4.843.294,00	45%	5.000.813,00
Left X	4.851.980,00	50%	5.013.160,50
Left P	5%	55%	5.025.292,00
Right X	5.175.737,00	60%	5.037.868,00
Right P	95%	65%	5.051.600,50
Diff X	323.757,00	70%	5.065.401,50
Diff P	90%	75%	5.080.369,00
#Errors	0	80%	5.097.214,00
Filter Min		85%	5.117.744,50
Filter Max		90%	5.141.714,00
#Filtered	0	95%	5.175.737,00

LCC3

- Are we authorised to introduce modifications in the process / specs?

- Upon identification of the most important costs, the attention is concentrated at the suitable technical solutions in order to select the most attractive in terms of LCC.

			specs	alternative	Difference
operation	**personnel**		U	U	
		operators	4	3	
		supervisor	1	1	
					16,67%
	chemicals		Kg/m3	Kg/m3	
		chlorine	1	1	
		lime	2	0	
		calcium	0	2	
					10%
	electricity		Kwh	Kwh	
		well pump	18	19	
		dissolvers	2	0	
		dosing	2	0	
		air blowers	8	0	
		backwash	3	1	
		boosters	30	30	
			63	50	20,63%
maintenance					
	preventative				
		well pump	yes	yes	
		dosing	yes	no	
		air blowers	yes	no	
		backwash	yes	yes	
		booster	yes	yes	
					19,05%
	reactive				
		well pump	yes	yes	
		dosing	yes	no	
		air blowers	yes	no	
		backwash	yes	yes	
		booster	yes	yes	
					19,05%

LCC3

- In our case the power from Electricity is the principal cost of operation and pumps are the topic equipment (Consuming more energy).
- We do concentrate therefore on a comparative LCC for different pumps.
- Multi criteria ?
- Deterioration ?

ELEMENT SELECTION

Booster pump

Click Get Data button to set Element selection ....

Dataset	CISE Demo	CISE Demo
Element	Water Installations	15 119 123 5
Sub-Element	Booster pump	123

0

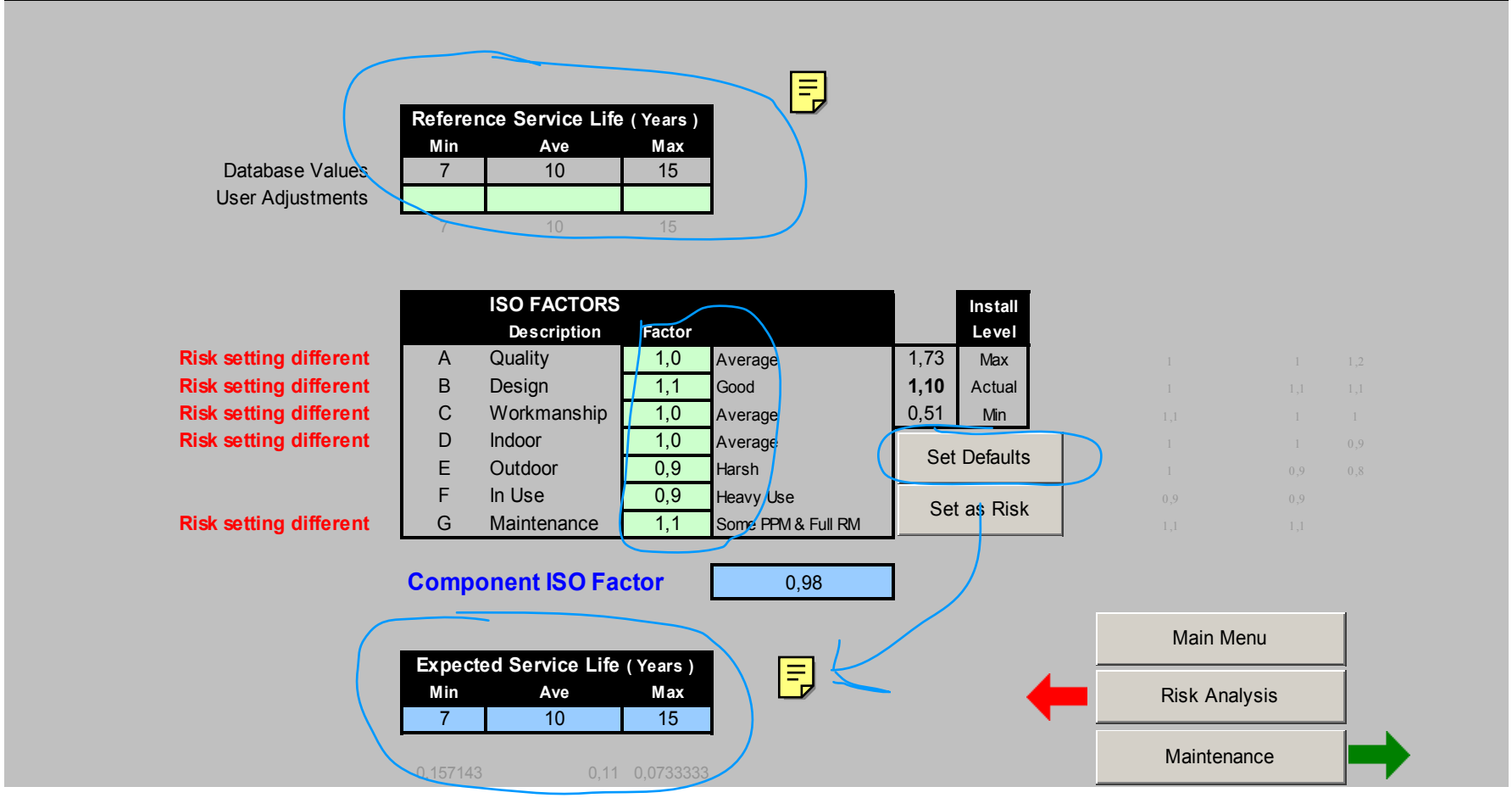
Is element accessible in service ?	☐	FALSO
Can the element be maintained ?	☑	VERO
Can the element be replaced ?	☑	VERO

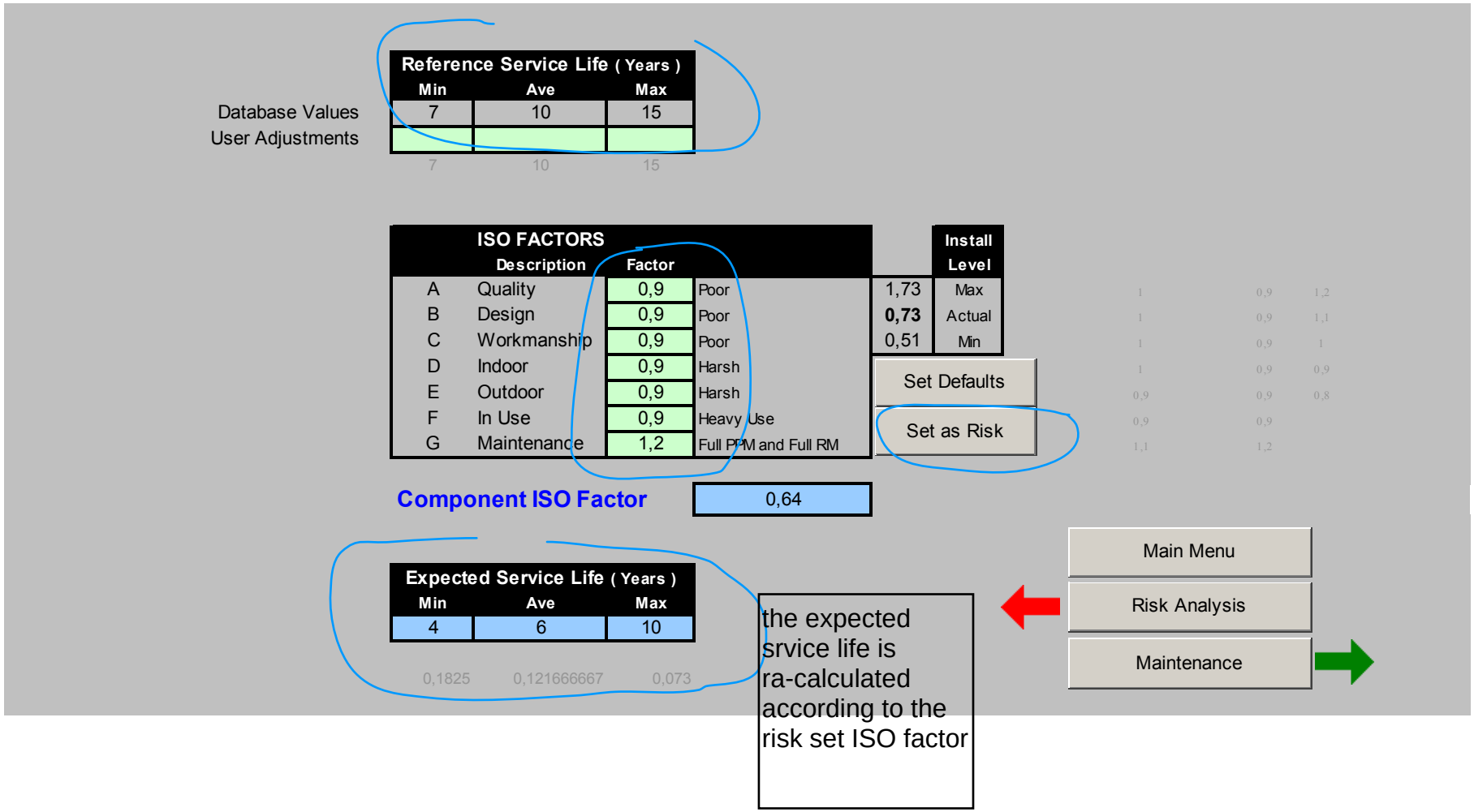
Main Menu

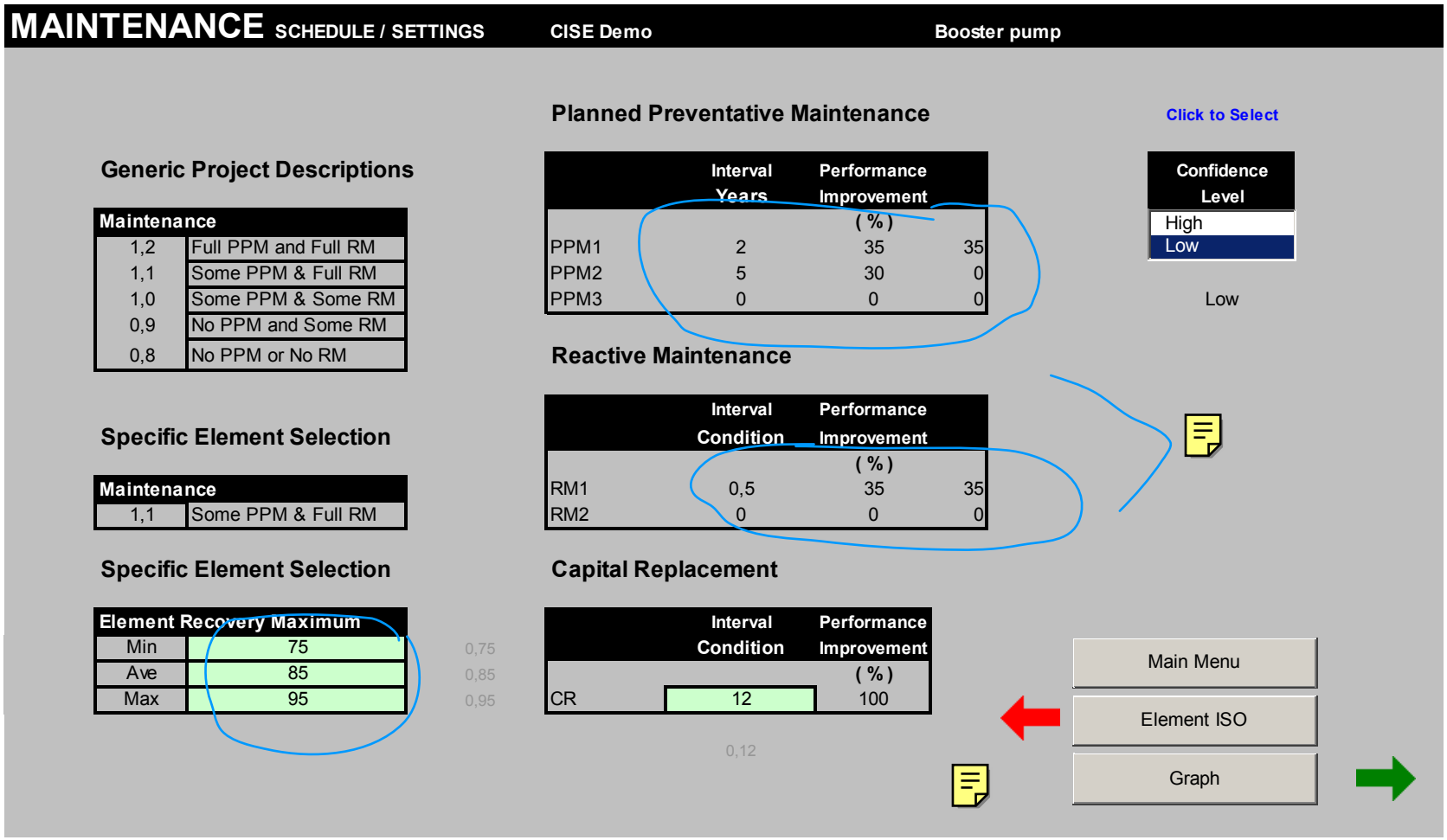
Project ISO

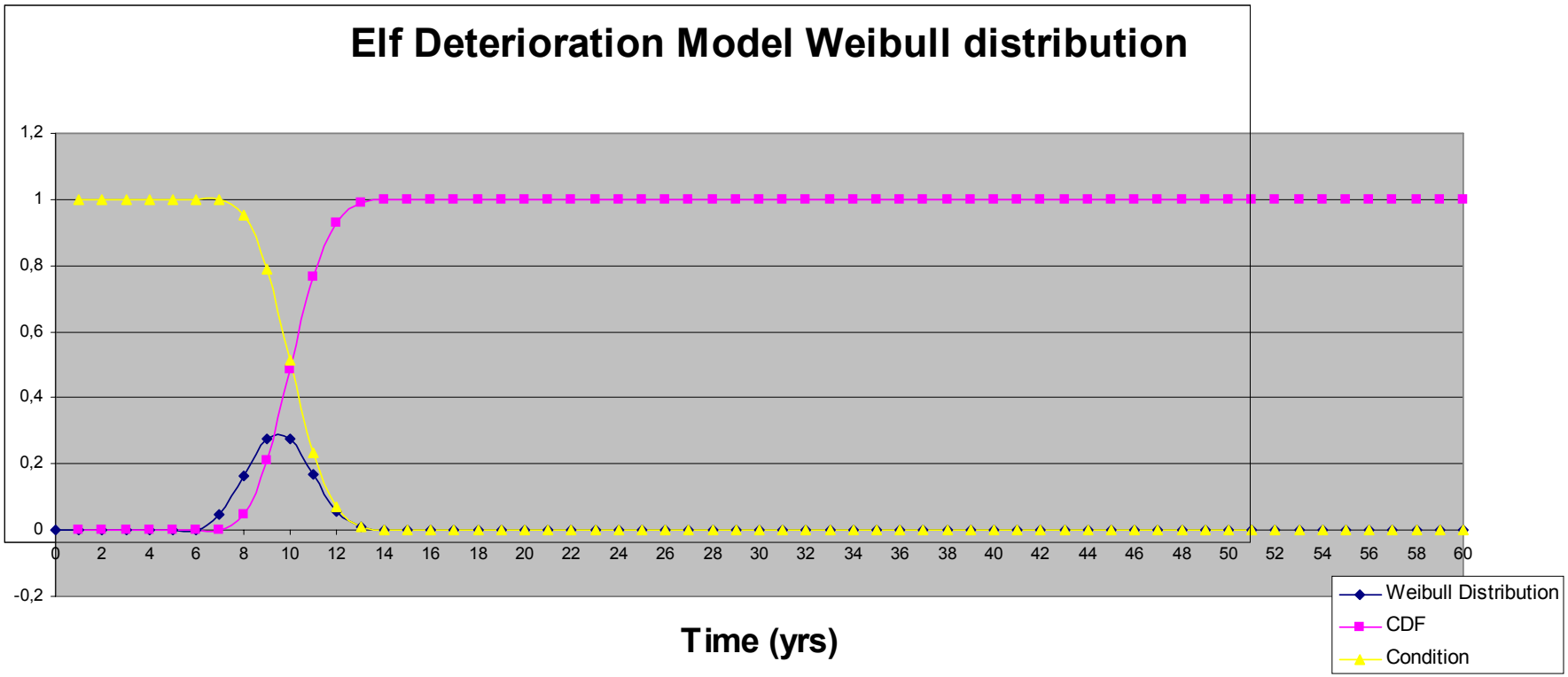
Risk Analysis

ISO FACTORS (Component Specific) CISE Demo Booster pump




Reference Service Life (Years)
Min
Ave
Max
Database Values
7
10
15
User Adjustments
7
10
15
ISO FACTORS
Description
Factor
Install Level
A Quality 0,9 Poor
B Design 0,9 Poor
C Workmanship 0,9 Poor
D Indoor 0,9 Harsh
E Outdoor 0,9 Harsh
F In Use 0,9 Heavy Use
G Maintenance 1,2 Full PPM and Full RM
1,73 Max
0,73 Actual
0,51 Min
Set Defaults
Set as Risk
Component ISO Factor
0,64
Expected Service Life (Years)
Min
Ave
Max
4
6
10
0,1825
0,121666667
0,073
the expected srvice life is ra-calculated according to the risk set ISO factor
Main Menu
Risk Analysis
Maintenance


MAINTENANCE SCHEDULE / SETTINGS
CISE Demo
Booster pump
Generic Project Descriptions
Maintenance
1,2 Full PPM and Full RM
1,1 Some PPM & Full RM
1,0 Some PPM & Some RM
0,9 No PPM and Some RM
0,8 No PPM or No RM
Specific Element Selection
Maintenance
1,1 Some PPM & Full RM
Specific Element Selection
Element Recovery Maximum
Min 75
Ave 85
Max 95
0,75
0,85
0,95
Planned Preventative Maintenance
Interval Years
Performance Improvement (%)
PPM1 2 35 35
PPM2 5 30 0
PPM3 0 0 0
Reactive Maintenance
Interval Condition
Performance Improvement (%)
RM1 0,5 35 35
RM2 0 0 0
Capital Replacement
Interval Condition
Performance Improvement (%)
CR 12 100
0,12
Click to Select
Confidence Level
High
Low
Low
Main Menu
Element ISO
Graph


Elf Deterioration Model Weibull distribution
1,2
1
0,8
0,6
0,4
0,2
0
-0,2
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60
Time (yrs)
Weibull Distribution
CDF
Condition

LIFE CYCLE COST

CISE Demo — Booster pump

Discount: 3,5

	Discount %	0	1	2	3	4	5	6	7	8	9	10	11	12
12	PPM1	0	1	1	1	1	1	1	1	1	1	1	1	1
6	PPM2	0	0	1	0	1	0	1	0	1	0	1	0	1
0	PPM3	0	0	0	0	0	0	0	0	0	0	0	0	0
5	RM1	0	0	0	0	0	0	0	0	1	1	1	1	1
0	RM2	0	0	0	0	0	0	0	0	0	0	0	0	0
1	CR	1	0	0	0	0	0	0	0	0	0	0	0	0
47.250,00	Cost	8.500,00	1.500,00	3.500,00	1.500,00	3.500,00	1.500,00	3.500,00	1.500,00	5.250,00	3.250,00	5.250,00	3.250,00	5.250,00
38.702,52	Discounted	8.500,00	1.449,28	3.267,29	1.352,91	3.050,05	1.262,96	2.847,25	1.178,99	3.986,91	2.384,63	3.721,82	2.226,07	3.474,36

LIFE CYCLE COST

CISE Demo — Booster pump

Discount: 3,5

	Discount %	0	1	2	3	4	5	6	7	8	9	10	11	12
12	PPM1	0	1	1	1	1	1	1	1	1	1	1	1	1
6	PPM2	0	0	1	0	1	0	1	0	1	0	1	0	1
0	PPM3	0	0	0	0	0	0	0	0	0	0	0	0	0
5	RM1	0	1	1	1	1	1	1	1	1	1	1	1	1
1	RM2	0	0	0	0	0	0	0	0	0	0	0	0	0
1	CR	1	0	0	0	0	0	0	0	0	0	0	0	0
59.500,00	Cost	8.500,00	3.250,00	5.250,00	3.250,00	5.250,00	3.250,00	5.250,00	3.250,00	5.250,00	3.250,00	5.250,00	3.250,00	5.250,00
49.402,97	Discounted	8.500,00	3.140,10	4.900,93	2.931,31	4.575,07	2.736,41	4.270,88	2.554,47	3.986,91	2.384,63	3.721,82	2.226,07	3.474,36

Deterioration Level 1 Data

Expected Service Life (Years)		
Min	Ave	Max
7	10	15

Deterioration Level 1 Data

Expected Service Life (Years)		
Min	Ave	Max
4	6	10

Deterioration Level 1 Data

Expected Service Life (Years)		
Min	Ave	Max
4	6	10

LIFE CYCLE COST PERFORMANCE MODEL - CONCEPT DESIGN STAGE

	Life Cycle Replacement (yrs)			Own distribution		Frequency of task (yrs)	YEAR 3	YEAR 4
	Min	Max	ML					
Pumps	4	10	6		Input Parameters	7		
Diffusers	5	10	7		Input Parameters	7		
Generators	8	12	10		Input Parameters	10		
Motor Valves	5	12	8	Lognormal	Input Parameters	10		
Services	3	6	5		Input Parameters	5		
External Works	1	10	5		Input Parameters	5		

	No of units			Own distribution	Cost per unit at replacement time			Own distribution	Frequency of task (yrs)	YEAR 3	YEAR 4
	Min	Max	ML		Min	Max	ML				
Pumps	8	12	9		4500	7500	5500		7		
Diffusers	4	4	4		12500	19000	15000		7		
Generators	1	2	1		25000	30000	27000		10		
Motor Valves	10	20	18		3000	5000	3800		10		
Services	5	15	12		1500	3500	2000		5		
External Works	20	50	35		3500	12500	9000		5		
Total										0,00	0,00
Present Value										0,00	0,00
Cumulative Present Value										0,00	0,00

POWER CALCULATION

$$P = \frac{Q \times H \times G}{366 \times \eta_p \times \eta_m} \quad (KW)$$

P	= power	Kw
Q	= flow rate	m3/hr
H	= Head total	m.
η_p	= pump efficiency	n
η_m	= motor efficiency	n
G	= specific gravity	

The basic LCC Equation for pumps

- LCC=Cic+Cin+Ce+Co+Cm+Cs+Cenv+Cd
- Cic initial cost, purchase price
- Cin installation and commissioning
- Ce energy cost
- Co operating cost (labour cost of operat.)
- Cm maintenance cost (parts, manhours)
- Cs down time, loss of production
- Cenv environmental costs
- Cd decommissioning cost

Life Cycle Cost Calculator

System description and pumps identification

Pouderoyen booster pump station - 66 l/sec.@37 m head

Alternative 1	MM 180-2	HE	86%
Alternative 2	SP 125 2-2	standard	70%

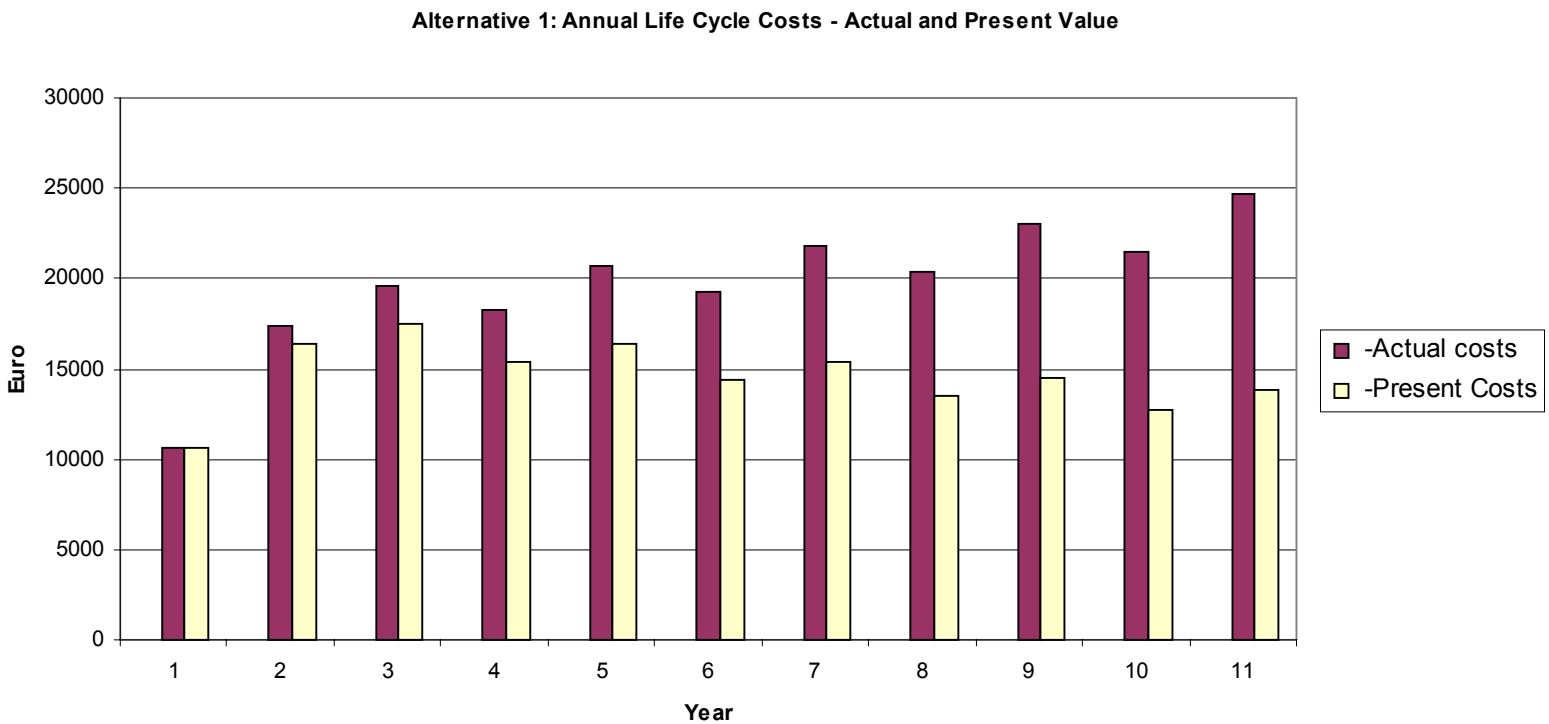
Input:(Insert datas where requested)

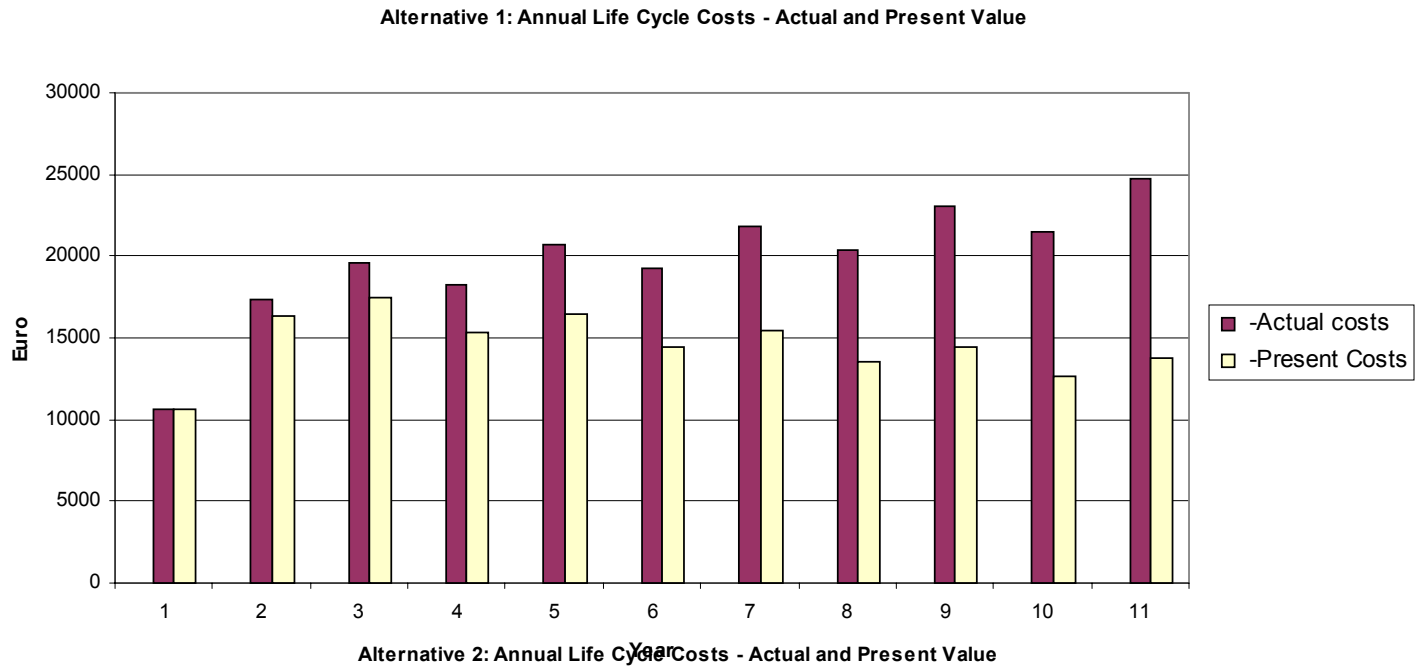
			Costs in € Alt. 1	Alt. 2
- First Investment Cost:			8.000,00	6.000,00
- Installation and Commissioning:			2.600,00	2.500,00
- Energy Price €/KWh:			0,08	0,08
- Weighted average power KW:			27,20	34,90
- Operating Hours (per year):			6.000	6.000
Energy Cost Calculated per year			13.056,00	16.752,00
- Operating Cost (per year):			1.260,00	1.260,00
- Preventive Maintenace (per year)- (2 inspections /year):			1.760,00	1.660,00
- Reactive Maintenance (per year) :			1.746,00	1.976,00
- Other Costs:			-	-
- Down Time Cost (per year):			800,00	600,00
- Environmental Cost: (read instructions)*	y	y	330,00	330,00
- Decommissioning / Disposal (-) / (+):			-	-
Life in years:			10	10
Interest rate, %:			6%	6%
Inflation rate, %:			2,7%	2,7%

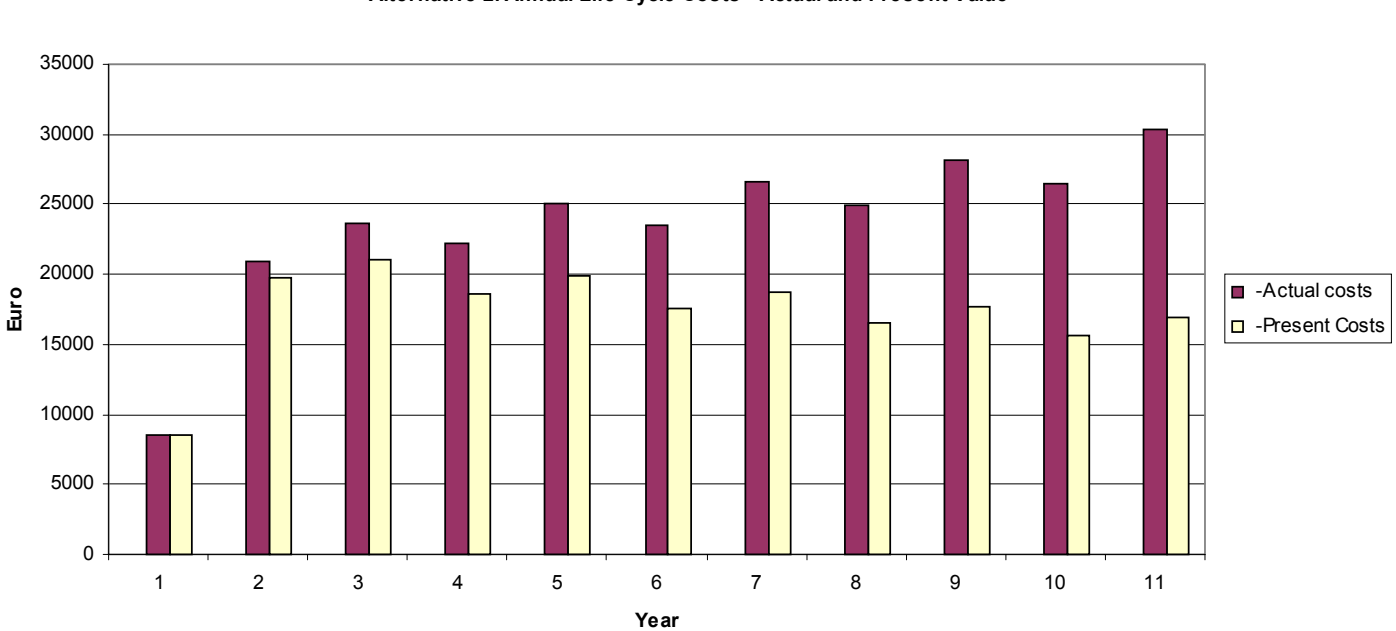
Output:

Expected Net Present LCC value	**€**	**166284**	**194557**
of which net present cost for energy :	€	110168	141355
and for preventive maintenance:	€	14851	14007

Energy Cost % :		66,25%	72,65%
preventive maintenance % :		8,93%	7,20%
Net Present O&M total cost % (on investment cost)		1946%	3101%
Pumping Cost per working hour / (m3)	€	0,012	0,014
Average present cost per year	€	16.628,35	19.455,73
Average Cost per month	€	1.385,70	1.621,31


Alternative 1: Annual Life Cycle Costs - Actual and Present Value
30000
25000
20000
15000
10000
5000
0
Euro
1
2
3
4
5
6
7
8
9
10
11
Year
-Actual costs
-Present Costs

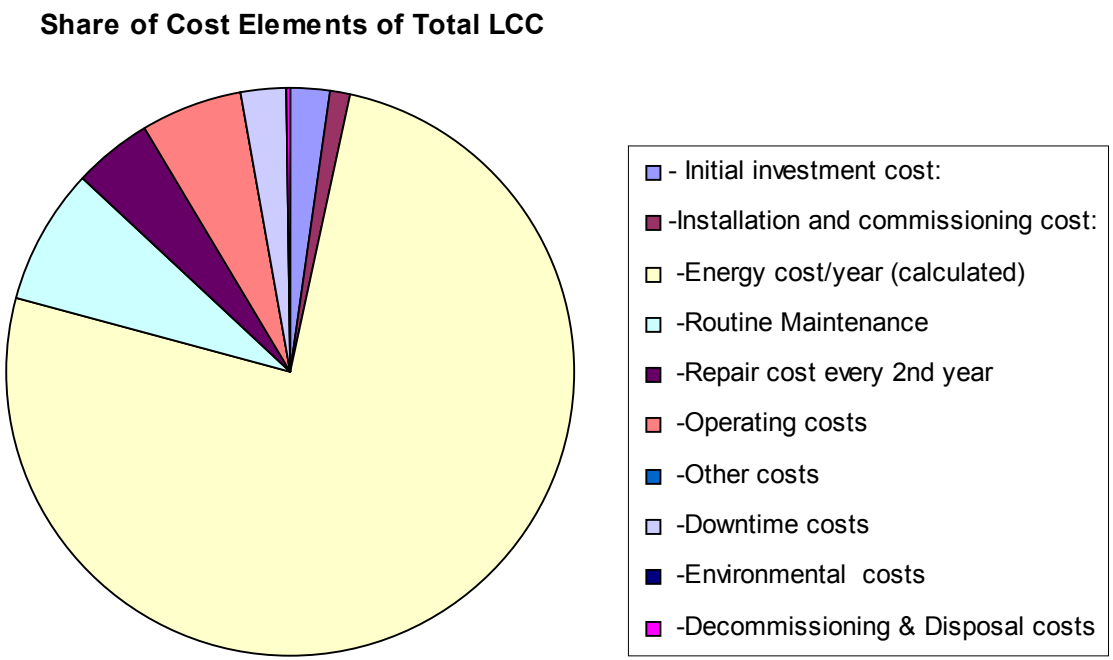

Alternative 1: Annual Life Cycle Costs - Actual and Present Value
30000
25000
20000
15000
10000
5000
0
Euro
1
2
3
4
5
6
7
8
9
10
11
Year
-Actual costs
-Present Costs


Alternative 2: Annual Life Cycle Costs - Actual and Present Value
35000
30000
25000
20000
15000
10000
5000
0
Euro
1
2
3
4
5
6
7
8
9
10
11
Year
-Actual costs
-Present Costs

LCC3

- Life span calculation is shorter (10 y) than the one (25-30 y) considered for the utility
- Calculation is more accurate with respect of forecast of inflation and interest rate.
- Environmental costs are direcly related to the process / equipment and not general
- How do we insert LCC in the calculator ?

the problem do not exist with the DM.


Share of Cost Elements of Total LCC
- Initial investment cost:
-Installation and commissioning cost:
-Energy cost/year (calculated)
-Routine Maintenance
-Repair cost every 2nd year
-Operating costs
-Other costs
-Downtime costs
-Environmental costs
-Decommissioning & Disposal costs

LCC summary

Tender specs

Expected Present Value	
3.154,91	
	% of LCC
883,33	28,00%
2.231,57	70,73%
1.361,13	43,14%
331,98	10,52%
191,39	6,07%
347,07	11,00%
-	0,00%
20,00	0,63%
20,00	0,63%

Alternative solution

Expected Present Value	
2.945,82	
	% of LCC
1.100,00	27,96%
1.805,82	70,64%
1.063,85	36,11%
261,06	8,86%
133,83	4,54%
347,07	11,78%
-	0,14%
20,00	0,63%
20,00	0,63%

- WTP
- Investment cost: +19.72%
- LCC: -21.0%

- Pumping station
- Investment cost: +33%
- LCC: - 14%