

# Project Fundamentals

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# ELPAVO Training Consultancies

- SAPCI – South African Project Control Institute.
- AACEI – The association for the Advancement of Cost Engineering International.
- ICEC – International Cost Engineering Council

# ELPAVO Training Consultancies

- Project Control
- Documentation Control
- Certified Cost Technicians - CCT
- Certified Cost Consultants/Engineers – CCC/CCE
- Earned Value Professionals - EVP
- Planning, Scheduling Professionals - PSP

# THE PROJECT FUNDAMENTALS

## *Cost Fields*

### OPEX

Operational expenditure  
(production costs)

### CAPEX

Capital expenditure  
(investments in new projects)

# THE PROJECT FUNDAMENTALS

## *Definition ~ Project*

An endeavour with a specific objective to be met within the *timeframe* and *fund* limitation.

AACE International

What should be in place  
before we start a project ?

The;

**The Up-Front  
Engineering!**

# The Up-Front Engineering

reflect

the strategic plan  
of the project

# THE PROJECT FUNDAMENTALS

1. Contract

2. Work Breakdown Structure

3. Scope Document

4. Scope Changes

5. Estimate

6. The Plan & Schedule

**A contract is a mutual business  
agreement recognized by law  
under which one party  
undertakes to do work for  
another party for consideration**

*(AACTE)*

*Consideration ... Compensation ...*

**A contract's major object is  
to reduce or avoid risk for  
all parties concerned.**

# **PARTIES INVOLVED**

- **OWNER**
- **ENGINEER**
- **CONTRACTOR**

## MAJOR TYPES

- REIMBURSABLE
- LUMP SUM – TURNKEY
- UNIT – PRICE
- TARGET
- NEW ENGINEERING CONTRACT



**The essences of  
these contracts**

## **THE REIMBURSABLE CONTRACT**

**The contractor is paid their legitimate actual cost incurred in performing the work plus a stipulated amount of profit**



## **THE LUMP-SUM CONTRACT**

**This is a fixed price turn-key contractual arrangement**

## **THE UNIT-PRICE CONTRACT**

**The price is fixed for each unit of work rather than the entire scope of work**



## **THE TARGET CONTRACT**

**The contractor prepares and negotiates a price with the owner not to exceed cost and time performance. This is then the target amount. At completion a comparison is made between the actual cost and the target cost. Compensation is then negotiated.**

## **THE NEW ENGINEERING CONTRACT**

**The NEC contract is a legal framework of project procedures designed to handle all aspects of construction projects. It's major benefit is it's flexibility and simplicity**



# REMEMBER !

**1. A contract should be the first line of Risk Management**

**2. Therefore the contract should be well-thought-out**



- **Courts will enforce contracts only when there is a consideration.**

# IMPORTANT CLAUSES

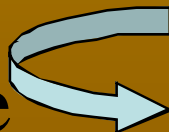
1. A Scope Document will baseline the scope of work
2. The procedures to register a Scope Changes




**In planning a project,  
management must structure  
the work into units that are:**

- Manageable, so that  
responsibility can be assigned**
- It should be independent, or  
with a minimum interaction  
with other ongoing tasks**

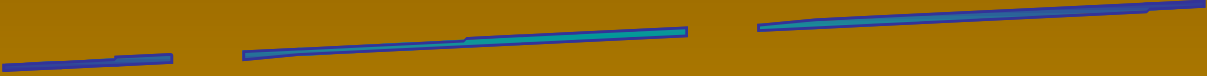
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- 
- **Integratable so that the total package can be seen as the goals are met?**
  - **It should be measurable in terms of progress**

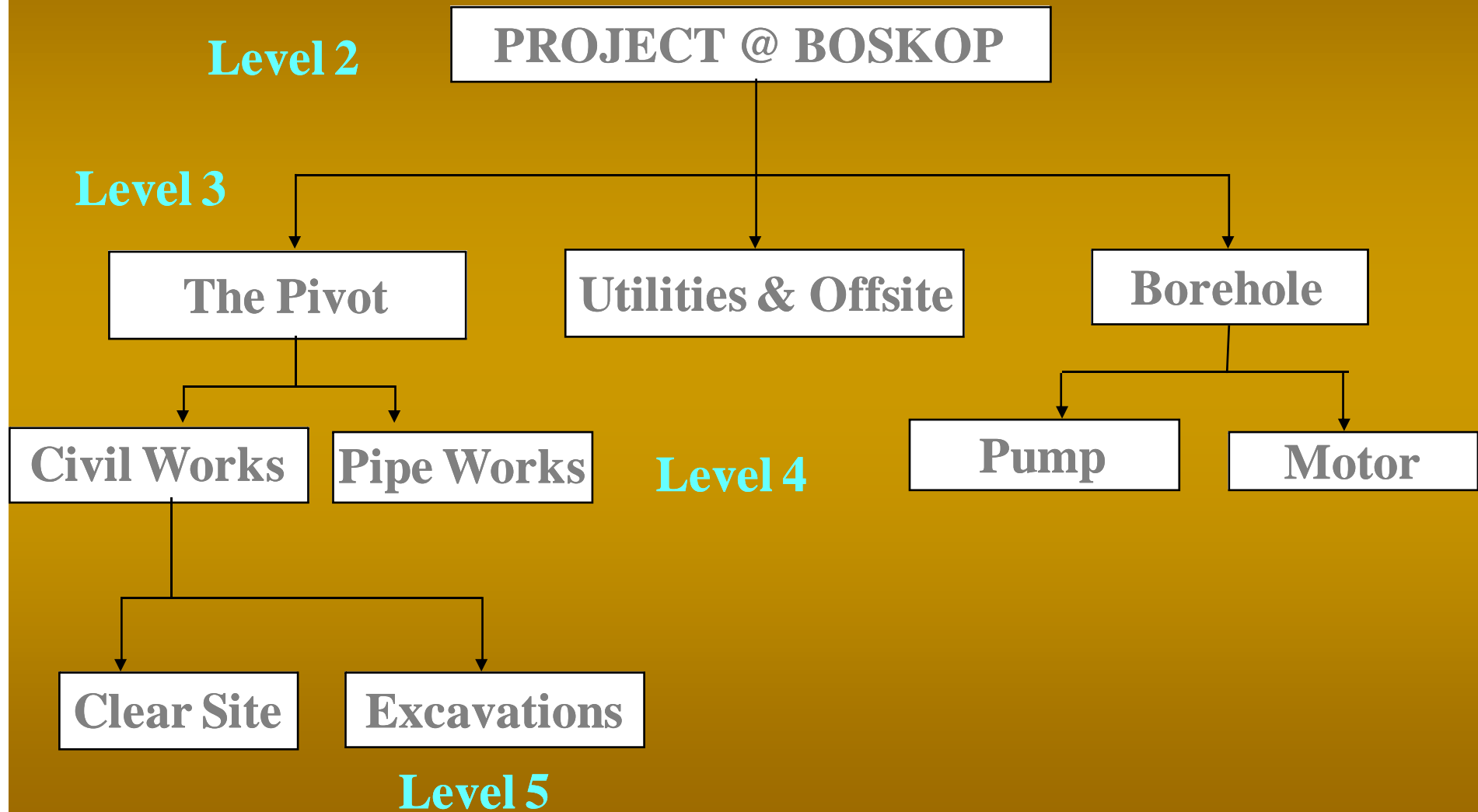


**This is only possible  
if management perform a  
Work Breakdown Structure**



**The purpose of a  
Work Breakdown Structure  
is to establish the  
Work Packages**

# Example





# Work Package

**Work packages is the smallest unit of work that can be completed independently. It consumes time and resources.**

**A value is attached to the  
Work Package**

# Work Package

Plan each part in detail. Take in consideration:

Equipment

&

Materials

- requirements
- availability
- transport
- constraints

Nothing is particularly  
hard if you divide  
it into small jobs

Start  
with the Scope  
Document

# PROJECT FUNDAMENTALS


## 3. Scope Document

A document with the sum of all that is to be invested in and delivered by the performance of an activity or project


**Definition**

**if we look at the definition**

**The term 'scope of work' is defined as what was agreed upon by the stakeholders to be delivered at an agreed price**



**The scope of work is a  
document and added to  
the contract as an  
appendix**



**It is good policy to define the scope of work in detail. Try to avoid vague descriptions of the work to be done.**



## Definition of a Battery Limit

***Geographic boundaries, imaginary or real, enclosing a area or unit of a plant.***

***The term can also be used in reference to single equipment and the small area around it.***

***(Dysert)***

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# The contents of a Scope Document

**Very important!**

**Start with a**

**~ Name of the Project**

**~ Base Date**



## Contents

- **Introduction**  
(Objective of the project)
- **Inclusions**  
(Elements of the task)
- **Exclusions**  
Supply of electricity & water

# Authorization

- **Battery Limits**  
(Disciplines)
- **Claims**  
(Incase of Scope Changes)
- **Safety**  
(South African OHS act & regulations)
- **Specifications**  
(Spec of work)



- **The design of the project**

- **Logical Diagram**

*or*

- **Milestone Level Schedule**

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Remember to

Baseline

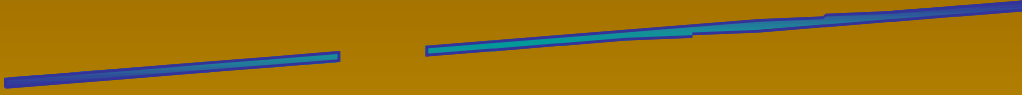
the scope of work!

# PROJECT FUNDAMENTALS

Any deviation from  
this scope is a  
Scope Change

# PROJECT FUNDAMENTALS

## 4. CHANGE MANAGEMENT

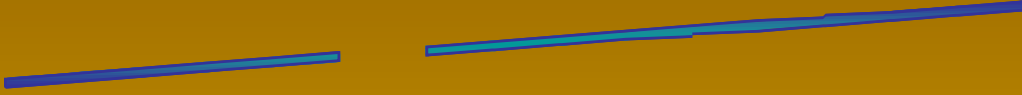
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- **A unilateral written order to a contractor to modify a contractual requirement within the scope of the contract in consultancy with the terms of the contract**
  - **A written order directing the contractor to make changes according to the provisions of the contract.**

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**Further:**  
A defined process for  
making changes to a  
project plan.

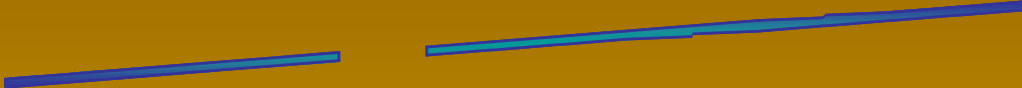
*(Wideman)*



**The policy on the  
procedure for change  
management must be in  
place and applied with  
every deviation of the  
scope of work**



If not documented  
this feature becomes a  
Scope Creep



**Manage a deviation from the scope  
as an addition to the scope;  
add the cost and time  
to the value of the project  
and authorize the document**

# THE PROJECT FUNDAMENTALS

With the contract in place and addressing Change Management, we perform the Work Breakdown Structure to identify the Work Packages so that it is possible to establish the Scope Document. It's now possible to do Definitive Estimating. Unfortunately ....

# THE PROJECT FUNDAMENTALS

**A senario!**

***You were out of office  
and on arrival at 17:00  
you notice a note  
on the computer.***

# THE PROJECT FUNDAMENTALS

## To: The Engineer

Sir, I have a meeting at eight o'clock with an important client from North West.

He wants to deforest a 100 hectares for cultivating lucerne and a Pivot Irrigation system. The land is situated near running water. What will the project cost?



# THE PROJECT FUNDAMENTALS

**This senario is a  
feasibility study !**

**WARNING !**

**'Good luck, sir!  
The project is yours'**

**A Tender Estimate**

# THE PROJECT FUNDAMENTALS

Never thumb-suck  
the value of project!

# 5. Estimating

## *Factor Estimating*

# 5. Estimating

The method of estimating depends on the detail available

Thus ...

The method of estimating is determined by the engineering done of the total design of the project.

# 5. Methods of Estimating

**Deterministic Calculation**

**Factoring**

**Conceptual Estimating**



# Method of Estimating

<u>Method</u>	<u>Knowledge Level</u>	<u>Estimate Type</u>
• Formula	0-2%	Order of Magnitude Class 5
• Factoring	1-15%	Budget Estimate Class 4
• Quotes rates factors	10-40%	Budget Estimate Class 3
• Deterministic	30-70%	Definitive Estimate Class 2
• Deterministic	40-80%	Definitive Estimate Class 1

# *Factor Estimating*

“A prediction of project cost made by applying and multiplying factors obtained from analysis of similar projects”

**Definition**

# *Factor Estimating*

**The knowledge level for  
Factor Estimating is:**

**1% to 15% for a  
economical feasibility  
study**

# *Factor Estimating*

**In this scenario the  
info is limited to the  
concept of the  
process and the  
output of the project**

# *Factor Estimating*

**COST is the value  
of an activity**

**That is all cost that  
can attribute to an  
activity**

# *Factor Estimating*

## **COST ESTIMATING**

**predicts the quantity  
and cost of all resources  
needed to accomplish  
all activities of a project**

*Factor Estimating*

**Requirements  
for F Factor  
Estimating**

# *Factor Estimating*

**1. Cost Structure**

**2. Historical Cost Data**

# *Factor Estimating*

The essential requirement for the estimating process is:

**A cost  
structured according  
to a universal  
accepted format**

# *Factor Estimating*

## 1. The Cost Structure

**The Cost Structure consist**  
**of:**      **Direct Field Cost**

**Indirect Field Cost**

**Home Office Cost**

**Other Cost**

# ESTIMATING CONCEPTS

## *1. Direct Field Cost*

*“The cost of all material, equipment and direct labour needed to build a plant, and which take part in the process for which the plant is designed.”*

# CAPITAL COST ESTIMATE

**PROJECT:**  
**Unit No:**  
**Base Date of Estimate:**  
**Summary by Prime Account:**  
**All Figures R 000's**

**Date:**  
**Prepared by:**  
**Checked by:**  
**Approved by:**

A/C	DIRECT FIELD COST DESCRIPTION	LABOUR		SUB CONTRACT R	MAT'L R	TOTAL R
		Hrs	R			
00	Earthworks / Civils					0
10	Concrete					0
20	Structural Steel					0
30	Buildings					0
40	Equipment & Machinery					0
50	Piping					0
60	Electrical					0
70	Instrumentation					0
83	Insulation / Fireproofing					0
85	Painting / Scaffolding					0
<b>TOTAL DIRECT FIELD COSTS</b>		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>



# ESTIMATING CONCEPTS

## *2. Indirect Field Cost*

*“The cost of all material, equipment and labour needed to build a plant but which do not take part in the process for which the plant is designed.”*

# CAPITAL COST ESTIMATE

**PROJECT:**

**Unit No:**

**Base Date of Estimate:**

**Summary by Prime Account:**

**All Figures R 000's**

**Date:**

**Prepared by:**

**Checked by:**

**Approved by:**

<b>INDIRECT FIELD COSTS</b>	
International Expenses	0
Temp. Construction Facilities & Buildings	0
Construction Vehicles	0
Construction Equipment	0
Small Tools & Consumables	0
Camp Costs & Catering	0
Construction Insurances	0
Construction Services & Utilities	0
Security	0
Construction Consultants	0
Field Staff and Travel Costs	0
Site Expenses	0
<b>TOTAL INDIRECT FIELD COSTS</b>	<b>0</b>
<b>TOTAL FIELD COSTS</b>	<b>0</b>



# ESTIMATING CONCEPTS

## *3. Home Office Costs*

*“Those costs and expenses incurred by all personnel in the execution of the design, engineering, construction, commissioning and control of a project.”*

# CAPITAL COST ESTIMATE

**PROJECT:**

**Unit No:**

**Base Date of Estimate:**

**Summary by Prime Account:**

**All Figures R 000's**

**Date:**

**Prepared by:**

**Checked by:**

**Approved by:**

<b>HOME OFFICE COSTS</b>	
Project Management & Services	0
Design, Engineering, Draughting & CAD	0
Construction Management & Services	0
Commissioning Management	0
Home Office Expenses	0
Consultants	0
<b>TOTAL HOME OFFICE COSTS</b>	<b>0</b>
<b>TOTAL FIELD &amp; OFFICE COSTS</b>	<b>0</b>



# ESTIMATING CONCEPTS

## *4. Other Costs*

*All other project related capital costs not covered by the previously mentioned cost groups.*

# CAPITAL COST ESTIMATE

**PROJECT:**

**Unit No:**

**Base Date of Estimate:**

**Summary by Prime Account:**

**All Figures R 000's**

**Date:**

**Prepared by:**

**Checked by:**

**Approved by:**

<b>OTHER COSTS</b>	
VAT	0
Escalation	0
Royalties & License Fees	0
Start-up Spares	0
Start-up Costs	0
Start-up Modifications	0
Catalyst & Chemicals (initial fill)	0
Owners Costs:Owners Team	0
-Training of Operators	0
- Owners Expenses	0
- Land Acquisition	0
- Plant Insurance	0
- Legal and Commercial Costs	0
Asset Disposals	0
<b>TOTAL OTHER COSTS</b>	<b>0</b>



# CAPITAL COST ESTIMATE

**PROJECT:**  
**Unit No:**  
**Base Date of Estimate:**  
**Summary by Prime Account:**  
**All Figures R 000's**

**Date:**  
**Prepared by:**  
**Checked by:**  
**Approved by:**

TOTAL FIELD, OFFICE & OTHER COSTS	0
CONTINGENCY @ %	0
TOTAL INSTALLED VALUE	0
<b>SAY</b>	<b>R 0</b>

**Let's move on**

# *Factor Estimating*

2.

# Historical

# Cost Data

*Factor Estimating*

The bases for

Factor Estimating is:

Data

# *Factor Estimating*

## 2. Historical data

- analysis of previous jobs
- percentages
- factors
- labour rates

# Historical Cost Data

**The info mentioned in  
the previous slide can  
be established with the**

# Close-out Report



# Close-out Report

## Direct Field Cost

	<u>Estimate</u>	<u>Final Cost</u>	<u>Variance</u>	<u>% of DFC</u>
Civil & Earths	4.2m	4m	0.2	10.00
Concrete	5.4m	5.7m	(0.3)	14.25
Structural Steel	3.4m	3.5m	(0.1m)	8.75
Equipment & Machinery	40m	40m	0m	41.67
Etc				
<b>Direct Field Cost</b>	<b>95m</b>	<b>96m</b>		<b>100.00</b>
Indirect Field Cost	9m	8.7m		
Home Office Cost	22m	21.4m		
Other Cost	14m	13.9m		
<b>Total Installed Value</b>	<b>140m</b>	<b>140m</b>		

Lessons Learned: Variance due to ...

# *Factor Estimating*

**From the previous  
information the  
Engineer develop the  
estimating factors**

# Factor Calculation

		Actual cost		Factor
Direct Field Cost	...	63%	...	1
Indirect Field Cost	...	10%	...	0.1587
Home Office Cost	...	13%	...	0.2064
Other Cost	...	14%	...	0.2222
Total Cost	...	100%	...	1.5873

Calculation:  $14 \div 63 \times 1 = 0.2222$

# *Factor Estimating*

**An explanation on  
Factor Estimating**

**Handout**

Ratio ~ labour:material

C&E ~ 97:3; E&M ~ 4:6

Factors: E & M as 1

C&E ~ 0.105; DFC ~ 2.4671

If DFC is 1 the factor for TIV  
~ 1.5810

# Factoring

Descrip	Labour	Mat	(Factor)	Total cost
	R	R		R
C & E	5.4 m	0.2 m	(0.105)	5.6 m
E & M	21m	32 m		53 m
DFC			(2.4671)	130.8 m
TIV			(1.5810)	206.8 m

**R207 000 000**

(Figures round)

# *Factor Estimating*

**Develop a data base on the  
relationship between  
Material cost & Labour cost**

# *Factor Estimating*

**Back to our senario  
on the pivot !**

# THE PROJECT FUNDAMENTALS

## To: The Engineer

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# *Factor Estimating*

**Let's do an**

**exercise**

**Handout**

*Factor Estimating*

Workshop

Pivot Irrigation System



# Factor Estimating

## Direct Field Cost

Name:

A/C Discipline

P101

P102

P103

A/C

F

Base date:

00	C & E	5.2	4.8	5.3	5.1	
10	Concrete	-	-	-	-	-
20	Buildings	4.9	5.2	4.9	5.0	
30	E & M	64.1	63.8	63.5	63.8	1
40	Piping	9.5	9.0	9.4	9.3	
50	Electrical	16.1	17.0	16.7	16.6	
60	Instrument	-	-	-	-	-
70	Insulation	-	-	-	-	-
80	Painting	0.2	0.2	0.2	0.2	





# Factor Estimating

## Direct Field Cost

1.5674

### A/C Discipline

### Average

### Factor

00 C & E

5.1

0.0799

10 Concrete

-

-

20 Buildings

5.0

0.0784

30 E & M

63.8

1.0000

40 Piping

9.3

0.1458

50 Electrical

16.6

0.2602

60 Instrument

-

-

70 Insulation

-

-

80 Painting

0.2

0.0031



# *Factor Estimating*

<u>Cost Groups</u>	<u>P101</u>	<u>P102</u>	<u>P103</u>	<u>Average</u>	<u>F</u>
<b>DFC</b>	96.6	96.4	95.9	96.3	<b>1.0000</b>
<b>IFC</b>	1.2	1.3	1.9	1.5	<b>0.0156</b>
<b>HOC</b>	0.9	1.4	1.4	1.2	<b>0.0125</b>
<b>OC</b>	1.3	0.9	0.8	1.0	<b>0.0104</b>
<b>TIV</b>	100	100	100	100	<b>1.0384</b>

# *Factor Estimating*

Discipline	Labour	Material	Total Cost
C & E	90	10	100
Concrete	-	-	-
Buildings	42	58	100
E & M	4	96	100
Piping	5	95	100
Electricals	48	52	100
Instrumen	-	-	-
Insulation	-	-	-
Painting	48	52	100



# Factor Estimating

Description	Labour	Material	Total Cost	Factor
C & E	36 489	4 055	40 533	0.0799
Concrete			-	-
Building	16 713	23 079	39 792	0.0784
E & M	20 213	485 120	507 546	1.0000
Piping	3 700	70 300	74 000	0.1458
Electrical	63 390	68 673	132 063	0.2602
Instrumen			-	-
Insulation			-	-
Painting	755	818	1 573	0.0031
DFC			795 527	1.5674
IFC			12 410	0.0156
HOC			9 944	0.0125
OC			8 273	0.0104
Contingency @ 6%			49 569	Total
			875 723	

**R876 000**



# *Factor Estimating*

## *Percentage development*

Percentage must be develop according averages as well as parameters with a best case scenario and worse cases scenario

# *Factor Estimating*

## *Idea's on Factors*

- 1. Transport cost**
- 2. Excavation cost**
- 3. Concrete cost**
- 4. Welding cost**
- 5. Borehole cost**

# *Factor Estimating*

Compensation factor

**An amount added to  
or subtracted from  
an estimate  
due to deviation**

# *Factor Estimating*

## Contingency

An amount added to an estimate to allow for unforeseeable conditions or events that may occurred generating additional cost

# Factor Estimating

<b>Sub Total</b>	<b>121 269</b>
<b>Compensation Factor (1%)</b>	<b><u>1 213</u></b>
<b><u>Total Cost</u></b>	<b>122 482</b>
<b>Contingency @ 6%</b>	<b><u>7 349</u></b>
<b>Total Installed Value</b>	<b><u>129 831</u></b>

**Thus R130 000**

# Factor Estimating

**Board approval**

1.24m

**Client**

1.21m

**Target**

1.14m

**Contractor**

1.21m

**Worse Case**

1.14m

**Target**

1.07m

**Best Case**

# *Factor Estimating*

## **Conclusion**

**Develop regularly Close-out Reports not only on projects but also on work packages to develop a defined and reliable data bank**

# *Factor Estimating*

## **Conclusion**

**If the historical cost data is defined the Factor Method of estimating may deviate less than 1% from a Definitive Estimate Class 1**

# *Factor Estimating*

## **Conclusion**

This form of estimating may be the route one should take to compensate for the lack of time when preparing estimates

# *Factor Estimating*

**Thank you for listening to us.  
We hope that you have more  
confidence in what you are  
going to do. If you would like  
to know more about**

***Project Control* contact**

**Marie @ 011 478 1540**

**Drive safely  
and enjoy  
the evening**