

**Success follows  
technical excellence**

GT – Competence Center  
Engineering & Maintenance



The Chemical Company

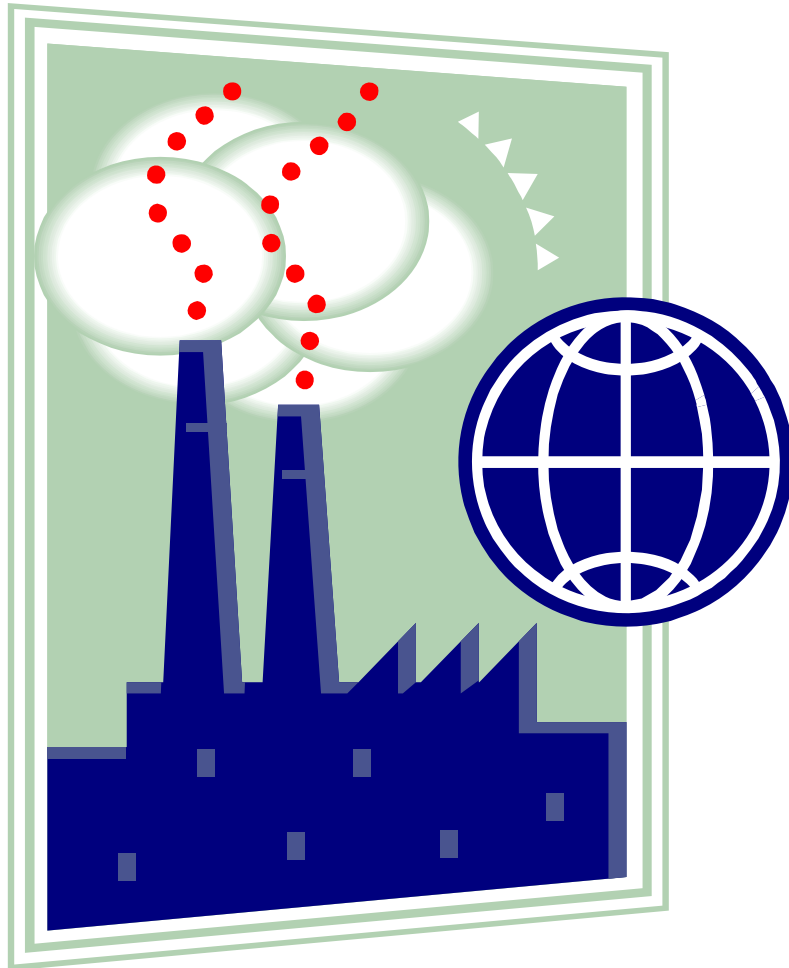


## **Determination of Foreign Country Estimating Factors**

Werner Pehlke

HGCS – aacei – Meeting  
February 8th, 2011 - Houston

# Determination of Foreign Country Factors Occasion

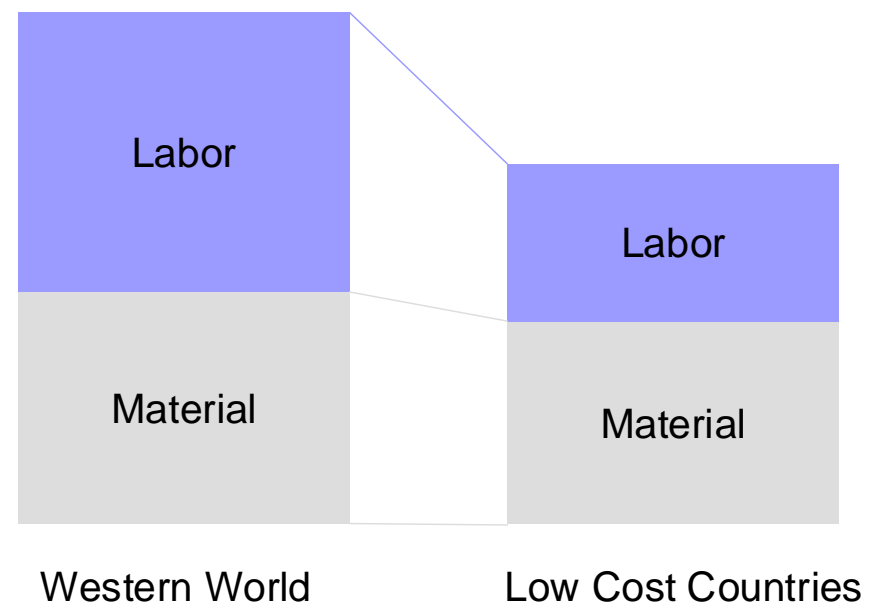


- Globalization of industrial production is increasing
- Increasing investments in new production sites in foreign countries
- Challenge for Cost Engineering
  - ▶ Constantly extension of data bases
  - ▶ Maintenance of foreign country cost data

# Determination of Foreign Country Factors

## Basic Model

- FC – costs are function of material price level and labor costs
- Material costs most often follow world market price levels
- Labor costs are function of hourly rates and productivity
- Labor costs are specific for the region or even country specific



**Data collection challenging**

# Determination of Foreign Country Factors

## Advantages for Factor Approach

- Significant less data required for foreign country estimates
- Less effort for data maintenance
- Available data for certain items can be used for similar other items where no data is available (e.g. similar equipment types)
- Analogies for different countries with similar economical boundary conditions possible
- BASF maintains factors for approx. 40 countries w/ up to 165 factors per country



**Factor approach more economically**

# Determination of Foreign Country Factors

## Granularity of Factors

- Different factors for different cost groups and even different cost items required (up to 165 per country in order to cover different project structures)

Bezeichnung	Dom-Anteil	Imp.-Ant.	Dom.-Fakt.	Importzusatzkosten	Anteile in Gruppen
<b>Civil</b>					
Kanäle	100,00%	0,00%			
Straßen	100,00%	0,00%			
Parkplätze	100,00%	0,00%			
Grünanlagen	100,00%	0,00%			
Geleise	100,00%	0,00%			
Weichen	100,00%	0,00%			
Rohrbrücken	100,00%	0,00%			
Pfahlgründung	100,00%	0,00%			
Erdarbeiten (incl. Erschließung)	100,00%	0,00%			
Betonbau	100,00%	0,00%			
Stahlbau	100,00%	0,00%			
Ausbau (Fenster, Türen, Dachdeckerarbeiten)	100,00%	0,00%			
Säureschutz	100,00%	0,00%			
Brandschutz	100,00%	0,00%			
Technische Bearbeitung	100,00%	0,00%			
Bauleitung	100,00%	0,00%			
Bauhilfsarbeiten	100,00%	0,00%			
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.					
.					
<b>Equipment</b>					
Wasserpumpe, CS, P<15kW	100,00%	0,00%			
Wasserpumpe, SS, P<15kW	100,00%	0,00%			
Chemie-Normpumpe, CS, einfache Ausführung	100,00%	0,00%			
Chemie-Normpumpe, SS, einfache Ausführung	100,00%	0,00%			
Chemie-Normpumpe, CS, >250m³/h, >200m	100,00%	0,00%			
Chemie-Normpumpe, SS, >250m³/h, >200m	100,00%	0,00%			
Spaltrohrmotorpumpe, CS	100,00%	0,00%			
Spaltrohrmotorpumpe, SS	100,00%	0,00%			
Magnetgekuppelt, CS, P<7,5 kW	100,00%	0,00%			
Magnetgekuppelt, SS, P<7,5 kW	100,00%	0,00%			
Dosierpumpe, CS	100,00%	0,00%			
Dosierpumpe, SS	100,00%	0,00%			
Ventilator, CS	100,00%	0,00%			
Ventilator, SS	100,00%	0,00%			
Vakuumpumpe, low power, dp<600mbar	100,00%	0,00%			
Kälteanlage	100,00%	0,00%			
N2-Verdichter	100,00%	0,00%			
Prozess-Verdichter, Schraubenverdichter	100,00%	0,00%			
Öl-freie Verd. pc<100bar, Wasserstoff-Verd.	100,00%	0,00%			
Hebeeinrichtungen	100,00%	0,00%			
Fördereinrichtungen	100,00%	0,00%			
.					
.					
.					

- ▶ Equipment, civil, electrical & instrumentation, piping etc.
- ▶ Carbon steel / stainless steel
- ▶ Domestic / imported
- ▶ Execution strategy EPC, complete owners engineering etc.

# Determination of Foreign Country Factors

## Basic Methods for Factor Generation

Factor  
calculation  
from  
executed Projects  
and / or  
external sources

Analogy Method

Mathematical Method



**Application depends on availability of Sources**

# Determination of Foreign Country Factors

## Sources for Factor Generation

### Internal Sources:

Executed Projects

Frame Contracts for  
Material & Services

Hourly Rates &  
Productivity Evaluation

### External Sources:

Public or Purchased Data  
e.g. EC Harrison, Eurostat,  
IPA-Reports etc.

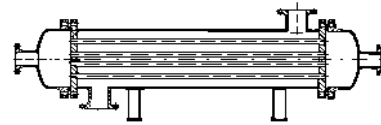
Contractor Data  
Regional experienced  
contractors

# Determination of Foreign Country Factors

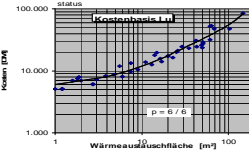
## Generation of Factors General Calculation Scheme

### MADE IN GERMANY

DIN



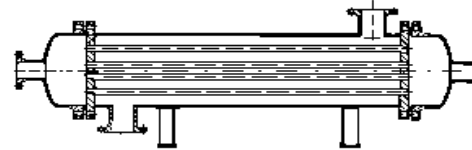
Mat. of Construction:	1.4541
Heat Exch. Area:	93 m <sup>2</sup>
Tubeside pressure:	40 bar
Shellside pressure:	10 bar



Estimated costs LU: 31.500 EUR

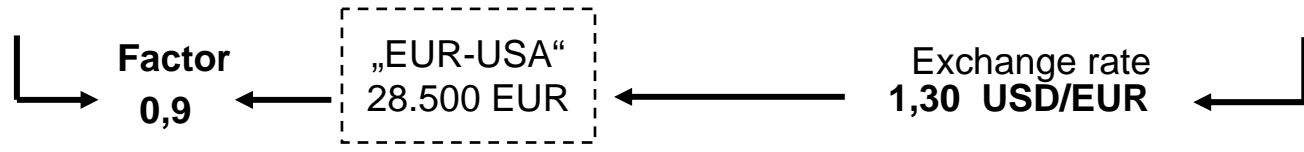
### MADE IN USA

ASME



Mat. of Construction:	304 L	(= 1.4541)
Heat. Exch. Area:	1000 sq. ft	(= 93 m <sup>2</sup> )
Tubeside pressure:	580 psi	(= 40 bar)
Shellside pressure:	145 psi	(= 10 bar)

Actual purchasing cost: 37.000 USD



LU Conditions

Foreign Conditions

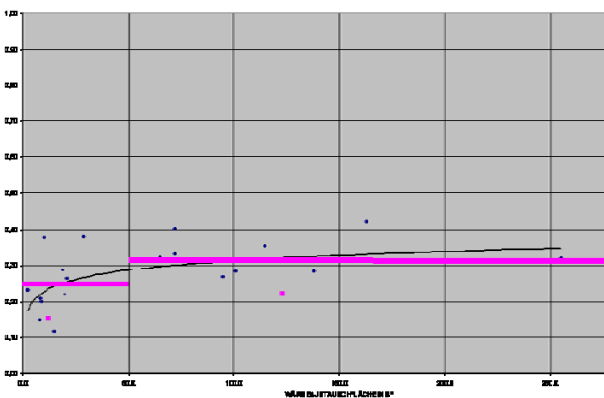


**Factor includes code & standard conversion and labor & productivity adjustment**

# Determination of Foreign Country Factors Analysis of Executed Projects

Ermittlung von Auslandsfaktoren  VR China  
 Projektname: **WU**  
 gewählter Datenbereich: **1.03.2003/03** **WÄRMETRÄGER**

Identifikation Job-Nr. / Pos. / Nr.	Werkstoff Arbeitschicht	Arbeitschicht Nachschicht	Kernenergie Parameter	Parameter pa in Bsp	Ermittlung Bemerkungen	Lokaler Standard	STARBUCK Kosten		Verort Kosten		Korrigierte Kosten für Programmierung Faktor	F (FAC)
							Basiss LU Stand	MBLJ	Detaillierte Kosten	Basiss LU Stand		
3600E2410	05	15,0	Wärme	Wärmeenergie	Wärping	13,00 DM	13,472 DM	13,472 DM	13,472 DM	13,472 DM	1,077 DM	8,15
3600E1107	05	8,0	Wärme	Wärmeenergie	Wärping	10,00 DM	10,179 DM	10,179 DM	10,179 DM	10,179 DM	1,491 DM	8,16
3720W22	05	12,0	Wärme	Wärmeenergie	Wärping	14,00 DM	13,842 DM	13,842 DM	13,842 DM	13,842 DM	2,123 DM	8,16
3600E2418	05	9,0	Wärme	Wärmeenergie	Wärping	10,00 DM	9,979 DM	9,979 DM	9,979 DM	9,979 DM	1,972 DM	8,26
3600E2422	05	9,0	Wärme	Wärmeenergie	Wärping	10,00 DM	9,979 DM	9,979 DM	9,979 DM	9,979 DM	1,972 DM	8,26
3600E2316	05	8,4	Wärme	Wärmeenergie	Wärping	9,00 DM	8,801 DM	8,801 DM	8,801 DM	8,801 DM	1,972 DM	8,21
3600E2423	05	20,0	Wärme	Wärmeenergie	Wärping	14,00 DM	14,470 DM	14,470 DM	14,470 DM	14,470 DM	3,150 DM	8,27
3720W10	05	10,0	Wärme	Wärmeenergie	Wärping	14,00 DM	14,470 DM	14,470 DM	14,470 DM	14,470 DM	3,150 DM	8,27
3600E2414	05	2,4	Wärme	Wärmeenergie	Wärping	6,00 DM	5,900 DM	5,900 DM	5,900 DM	5,900 DM	1,303 DM	8,25
3600E2412	05	34,0	Wärme	Wärmeenergie	Wärping	19,00 DM	19,400 DM	19,400 DM	19,400 DM	19,400 DM	4,732 DM	8,24
3600E2308	05	19,1	Wärme	Wärmeenergie	Wärping	14,00 DM	14,470 DM	14,470 DM	14,470 DM	14,470 DM	3,549 DM	8,26
3600E2420	05	21,0	Wärme	Wärmeenergie	Wärping	15,00 DM	14,900 DM	14,900 DM	14,900 DM	14,900 DM	3,943 DM	8,26
3600E2313	05	86,0	Wärme	Wärmeenergie	Wärping	37,00 DM	36,523 DM	36,523 DM	36,523 DM	36,523 DM	9,889 DM	8,27
3600E1207	05	101,0	Wärme	Wärmeenergie	Wärping	39,00 DM	38,919 DM	38,919 DM	38,919 DM	38,919 DM	10,363 DM	8,26
3600E2314	05	130,0	Wärme	Wärmeenergie	Wärping	49,00 DM	48,994 DM	48,994 DM	48,994 DM	48,994 DM	13,802 DM	8,26
3600E2407	05	19,0	Wärme	Wärmeenergie	Wärping	14,00 DM	14,470 DM	14,470 DM	14,470 DM	14,470 DM	4,141 DM	8,29
3600E2001	05	296,0	Wärme	Wärmeenergie	Wärping	89,00 DM	89,328 DM	89,328 DM	89,328 DM	89,328 DM	24,421 DM	8,29
3600E1200	05	86,0	Wärme	Wärmeenergie	Wärping	30,00 DM	30,437 DM	30,437 DM	30,437 DM	30,437 DM	8,981 DM	8,37
3600E2400	05	72,0	Wärme	Wärmeenergie	Wärping	30,00 DM	30,437 DM	30,437 DM	30,437 DM	30,437 DM	10,086 DM	8,35
3600E2306	05	119,0	Wärme	Wärmeenergie	Wärping	43,00 DM	42,911 DM	42,911 DM	42,911 DM	42,911 DM	16,103 DM	8,36
3720W40	05	10,0	Wärme	Wärmeenergie	Wärping	15,00 DM	14,931 DM	14,931 DM	14,931 DM	14,931 DM	5,591 DM	8,37
3720W21	05	29,0	Wärme	Wärmeenergie	Wärping	34,00 DM	33,917 DM	33,917 DM	33,917 DM	33,917 DM	12,722 DM	8,36
3600E2301	05	72,0	Wärme	Wärmeenergie	Wärping	30,00 DM	30,437 DM	30,437 DM	30,437 DM	30,437 DM	12,229 DM	8,40
3600E1206	05	163,0	Wärme	Wärmeenergie	Wärping	66,00 DM	65,920 DM	65,920 DM	65,920 DM	65,920 DM	22,660 DM	8,47
3720W23	05	26,0	Wärme	Wärmeenergie	Wärping	26,00 DM	24,718 DM	24,718 DM	24,718 DM	24,718 DM	11,796 DM	8,48
3720W10	05	13,0	Wärme	Wärmeenergie	Wärping	17,00 DM	16,801 DM	16,801 DM	16,801 DM	16,801 DM	8,207 DM	8,49
3720W41	05	14,0	Wärme	Wärmeenergie	Wärping	18,00 DM	17,797 DM	17,797 DM	17,797 DM	17,797 DM	8,914 DM	8,50
3720W42	05	23,0	Wärme	Wärmeenergie	Wärping	29,00 DM	29,281 DM	29,281 DM	29,281 DM	29,281 DM	11,499 DM	8,50
3720W11	05	74,0	Wärme	Wärmeenergie	Wärping	50,00 DM	50,300 DM	50,300 DM	50,300 DM	50,300 DM	27,913 DM	8,55
3720W20	05	40,0	Wärme	Wärmeenergie	Wärping	44,00 DM	43,934 DM	43,934 DM	43,934 DM	43,934 DM	25,090 DM	8,56
3720W26	05	9,0	Wärme	Wärmeenergie	Wärping	14,00 DM	13,942 DM	13,942 DM	13,942 DM	13,942 DM	7,989 DM	8,56
3720W27	05	20,0	Wärme	Wärmeenergie	Wärping	21,00 DM	20,763 DM	20,763 DM	20,763 DM	20,763 DM	13,313 DM	8,64
3720W11	05	10,0	Wärme	Wärmeenergie	Wärping	10,00 DM	14,091 DM	14,091 DM	14,091 DM	14,091 DM	8,929 DM	8,64
3720W19	05	116,0	Wärme	Wärmeenergie	Wärping	69,00 DM	68,222 DM	68,222 DM	68,222 DM	68,222 DM	45,462 DM	8,67
3720W13	05	28,0	Wärme	Wärmeenergie	Wärping	109,00 DM	107,772 DM	107,772 DM	107,772 DM	107,772 DM	61,262 DM	8,68
3720W19	05	149,0	Wärme	Wärmeenergie	Wärping	84,00 DM	83,063 DM	83,063 DM	83,063 DM	83,063 DM	69,192 DM	8,71



- Analysis of executed projects serves as a main source for foreign country factors
- Re-estimating as built quantities with most current tools & cost data
- Calculating foreign country factors for each “Cost Item”
- Evaluating factors by printing graphs and applying a smoothing function

# Determination of Foreign Country Factors

## Goods Basket

GroupDC Equipment	specification	Material	Flow (m³/h)	Head	Seal	Unit	LU Price (Euro)	Local Price (Local Currency)	faktor
	Centrifugal Pump without Motor	SS	10	30	Single	Cost per Unit			0
		SS	30	30	Single				0
		Cast Iron	30	30	Single				0
		SS	30	30	Canned				0
	specification	Power (kW)	Voltage (V)		Other	Unit	LU Price (Euro)	Local Price (Local Currency)	
	Motor	5	400		Explosion proof type	Cost per Unit			0
					...				
	specification	Material	Area (m²)	Pressure Shell (bar)		Unit	LU Price (Euro)	Local Price (Local Currency)	
	Tube Heat Exchanger	CS	10	5		Cost per Unit			0
SS		0							
Plate Heat Exchanger	CS	10	5		Cost per Unit			0	
	SS							0	
specification	Material	Capacity (m³)	Pressure Shell (bar)		Unit	LU Price (Euro)	Local Price (Local Currency)		
Process Vessel without agitator	SS	20	15 / (-1)		Cost per unit			0	
Vertical Storage Tank	CS	100	pressureless		Cost per Unit			0	
	SS							0	
	FRP							0	
Vertical Vessel	CS	10	4					0	
	SS							0	

- Goods basket with Key Quantities for all disciplines available
- Contractor or local engineering unit should be able to fill out
- Due to complexity of key quantities and specific costs explanation required



**Factor evaluation on estimating basis**

# Determination of Foreign Country Factors Fantage Planning Package

**CONFIDENTIAL**  
FANTAGE



25.000 t/a Fantage Project  
Project Description

- Planning Package for fictitious plant available
- Civil description, P&ID's, equipment list, pipeline list, instrument list
- Utilized for factor evaluation with contractors and inhouse engineering units



**Factor evaluation on estimating basis**

# Determination of Foreign Country Factors „Analogy Model“

X-Country \_\_\_\_\_ Date \_\_\_\_\_  
1 EUR = x.x YYY

Gruppe	Anteil LU Gewichtung %	Umfang	Domestic-Faktoren							
			Quelle 1	Quelle 2	X-Country			Gesamt-Faktor gewährt	bisher Faktoren Blank stand 12.99	Vergleichen mit Y-Country
					min	durch.	max			
Spalte	0	1								
A		Erschließung			0,95	0,90	0,85		0,66	
		Straßen			0,95	0,90	0,85		0,66	
		Kanäle			0,95	0,90	0,85		0,66	
		Rohrbrücken			0,90	0,87	0,84		0,66	
		Pfählung			0,90	0,87	0,84		0,83	
		Beton			0,92	0,88	0,85		1,02	
		Stahibau			0,89	0,87	0,84		1,02	
		Ausbau			0,93	0,89	0,85		1,02	
		Techn. Bearb.			1,00	0,93	0,86		1,02	
Bauhilfsarb.			0,93	0,89	0,85		0,83			
	100	Durchschnitt Gr. A			<b>0,92</b>	<b>0,88</b>	<b>0,85</b>		<b>0,96</b>	
B		Isolierung			0,99	0,93	0,88		1,18	
		Anstrich			0,99	0,93	0,87		0,83	
		HKL			0,98	0,93	0,89		1,00	
	100	Durchschnitt Gr. B			<b>0,98</b>	<b>0,93</b>	<b>0,88</b>		<b>1,07</b>	
C		Fahrzeuge, Werkz.			1,07	1,07	1,07		1,22	
		Laborg., Möbel			1,04	1,03	1,02		0,61	
		EDV			1,06	1,06	1,06		1,00	
	100	Durchschnitt Gr. C			<b>1,05</b>	<b>1,05</b>	<b>1,04</b>		<b>0,91</b>	
D-G		Serienmasch.			1,03	1,02	1,00		0,93	
		Sondermaschinen			1,03	1,02	1,00		1,22	
		Apparate CS			1,03	1,02	1,00		0,93	
		Apparate SS			1,04	1,03	1,02		1,22	

- Well known country of the same region used as a reference
- Labor costs & efficiencies needs to be similar
- Raw material availability (eg. steel mills etc.) needs to be comparable
- Serves as “Check & Balance” during factor evaluation process



**Factor evaluation on estimating basis**

# Determination of Foreign Country Factors Mathematical Model (Plausibility)

X-Country  
Status: Date  
Exchange Rate:  
Größe

Wurde mit den von Mixed Currency korrigiert Faktoren gerechnet  
Verteilung Material-Anteil =  $x \% \text{ Dom. "Offshore"-Anteil} + (1-x) \% \text{ Dom. "Onshore"-Anteil}$   
 $x = 0,95$

Größe	Material-Anteil					Fertigungs-Anteil				Masch-Anteil	Gesamt-Faktor	
	Mat.-anteil	Domestic "Offshore"-Anteil	Domestic "Onshore"-Anteil	Offshore-Faktor	Onshore-Faktor	Fert.-Anteil	Faktor	Arbeits-anteil	Arbeits-Faktor			
Equipment type X												
10	30%	29%	2%	1,00	1,27	70%	0,68	70%	0,68	0%	1,00	0,78
50	33%	31%	2%	1,00	1,27	67%	0,68	67%	0,68	0%	1,00	0,79
100	36%	34%	2%	1,00	1,27	64%	0,68	64%	0,68	0%	1,00	0,80
250	50%	48%	3%	1,00	1,27	50%	0,68	50%	0,68	0%	1,00	0,85
500	70%	67%	4%	1,00	1,27	30%	0,68	30%	0,68	0%	1,00	0,91
Durchschnitt Gr. A	44%	42%	2%			56%		56%		0%		0,83
Equipment type Y												
10	40%	38%	2%	1,00	1,27	60%	0,68	60%	0,68	0%	1,00	0,81
50	50%	48%	3%	1,00	1,27	50%	0,68	50%	0,68	0%	1,00	0,85
100	60%	57%	3%	1,00	1,27	40%	0,68	40%	0,68	0%	1,00	0,88
250	65%	62%	3%	1,00	1,27	35%	0,68	35%	0,68	0%	1,00	0,90
500	70%	67%	4%	1,00	1,27	30%	0,68	30%	0,68	0%	1,00	0,91
Durchschnitt Gr. A	57%	54%	3%			43%		43%		0%		0,87
Equipment type Z												
10	55%	52%	3%	1,00	1,27	45%	0,68	45%	0,68	0%	1,00	0,86
50	58%	55%	3%	1,00	1,27	42%	0,68	42%	0,68	0%	1,00	0,87
100	60%	57%	3%	1,00	1,27	40%	0,68	40%	0,68	0%	1,00	0,88
250	60%	57%	3%	1,00	1,27	40%	0,68	40%	0,68	0%	1,00	0,88
500	60%	57%	3%	1,00	1,27	40%	0,68	40%	0,68	0%	1,00	0,88
Durchschnitt Gr. A	59%	56%	3%			41%		41%		0%		0,88

- For equipment for instance material, fabrication & labor and onshore & offshore portion is calculated separately
- Respective factors for the different portions above are applied and a composite factor is calculated
- The factor from other methods will be compared with the composite factor as a plausibility check

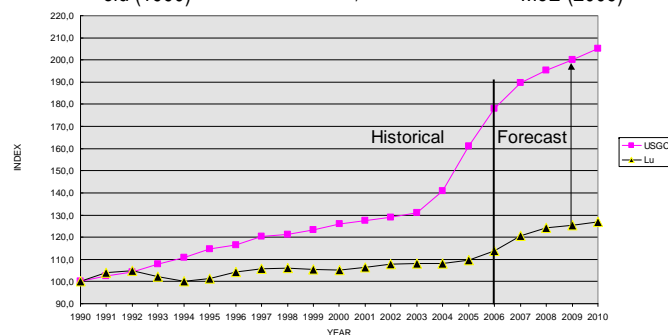
 Factor evaluation based on analytical model

# Determination of Foreign Country Factors

## Maintaining Factor Basis

$$\text{Factor}_{\text{new}} = \text{Factor}_{\text{old}} \times \frac{\text{Foreign Price Index}}{\text{LU Price Index}}$$

e.g.: Factor = 0,9 old (1990)  $\xrightarrow{1 \text{ EUR} = 1,3 \text{ USD}}$  Factor = 1,4 MoE (2009)

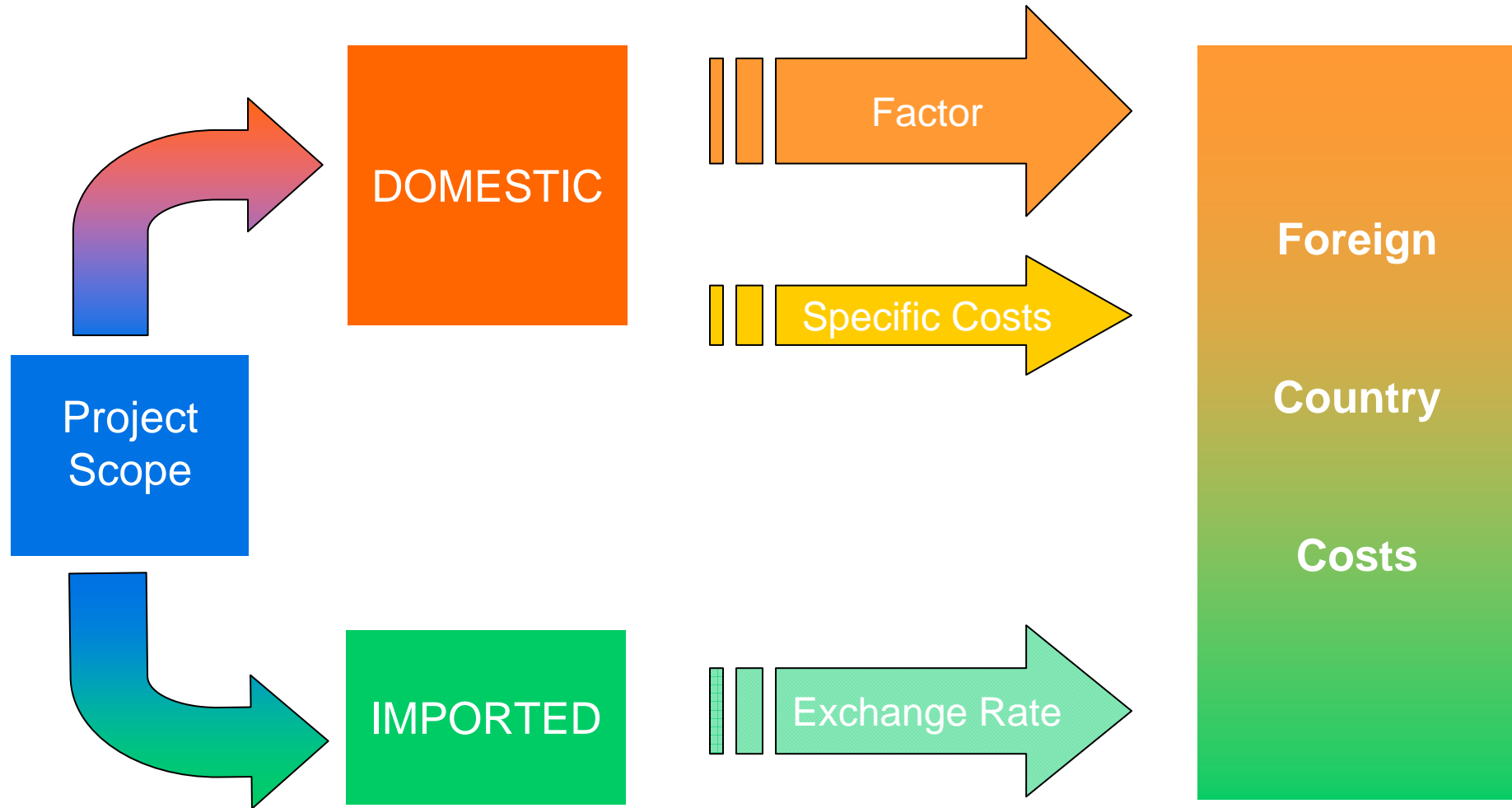


- Factors were influenced by inflation rates from home base country and foreign country
- Update to current conditions necessary for estimating purpose
- Ratio of inflation rates can be used for update
- Reevaluation necessary after certain period of time

 **Factor update by means of inflation ratios**

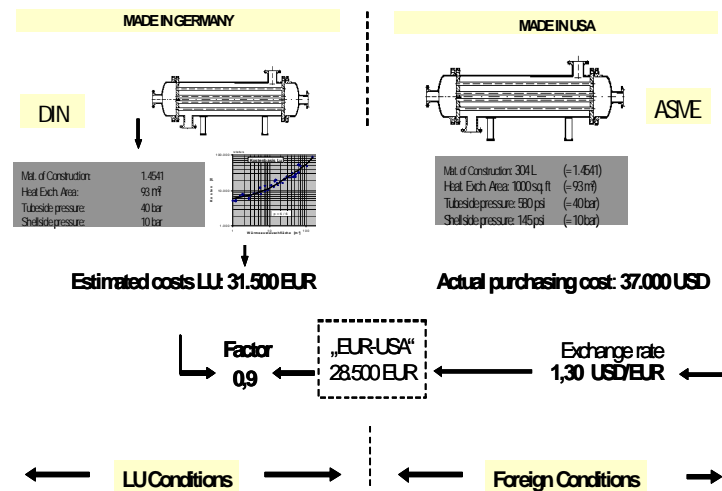
# Determination of Foreign Country Factors

## Estimating with foreign country factors



# Determination of Foreign Country Factors

## Estimating with foreign country factors



- Factors will be updated with ratio of inflation rates
- Estimating of cost items with home database per today (overnight)
- Application of factors & related exchange rate (reverse calculation from factor evaluation)
- Application of foreign country inflation rate to midpoint of expenditure

**Results in foreign country conditions & currency**

# Determination of Foreign Country Factors

## Influences on Foreign Country Estimates

### Project-Specific Influences:

Project cost structure

Standard practices  
(eg. Steel vs. concrete)

Material of construction

Import/Domestic Split

Execution Strategy

### Site Influences:

Climatic conditions

Legal requirements,  
codes, standards

Salary level

Existing infrastructure  
and logistics

### Economic Influences:

Currency parities

Duties/Taxes

Inflation

Possible special  
local-market influences

# Determination of Foreign Country Factors

## Most common traps w/ comparing foreign investment figures



- Scope is not comparable  
e.g. Verbund site vs. stand alone site
- Factors from former projects applied  
with different exchange rate
- High inflation ratio compared to former  
project (e.g. situation at Gulf Coast  
region after hurricane Katrina)
- Different execution strategies apply



**Cost Engineering can support “Apples to Apples- Comparison”**



**Thank You**

**for**

**Your Attention**