Relation between equipment cost (C) and time. I is the value of a cost index such as CEPCI in a given year.

$$C_2 = C_1 \left(\frac{I_2}{I_1}\right)$$

Relation between Cost (C) and Equipment size (A=Attribute). n=0.6 on average (calculate if data available)

$$C_a = C_b \left(\frac{A_a}{A_b}\right)^n$$

A simple estimate of total module cost (C_{TM}). Lang Factor (F_{Lang}) is 4.74 for fluids, 3.1 for solids, 3.63 for plants that handle both solids and fluids. C_p is purchased cost for a piece of equipment. Number of pieces of equipment is n.

$$C_{TM} = F_{Lang} \sum_{i=1}^{n} C_{p,i}$$

Bare module cost (C_{BM}). Purchased cost at base conditions (C_p°). Bare module factor (F_{BM})

$$C_{BM} = C_p^\circ F_{BM}$$

Values for constants K are found in Appendix A1 for many types of equipment

$$log(C_p^\circ) = K_1 + K_2 \log(A) + K_3 [\log(A)]^2$$

Pressure Factor for Vessels (F_P):

$$F_{P,vessel} \begin{cases} = 1 & t_{vessel} < 0.0063m \\ = \dfrac{\dfrac{PD}{2(944)(0.9) - 1.2P} + 0.00315}{0.0063} & t_{vessel} > 0.0063m \text{ and } P > -0.5barg \\ = 1.25 & P < -0.5barg \end{cases}$$

Pressure Factor for Other Equipment (values of constants, C, found in Appendix A2)

$$log(F_P) = C_1 + C_2 \log(P) + C_3 [\log(P)]^2$$

Bare Module Factors and Material Factors for Heat Exchangers Vessels and Pumps (A3 and A4)

$$C_{BM} = C_P^\circ F_{BM} = C_P^\circ (B_1 + B_2 F_M F_P)$$

Other equipment C_{BM} equations given in Table A5, F_{BM} values in Tables A6 and A7

$$C_{TM} = 1.18 \sum_{i=1}^{n} C_{BM,i}$$

$$C_{GR} = C_{TM} + 0.5 \sum_{i=1}^{n} C_{BM,i}^\circ$$

$$FCI_L = \begin{cases} C_{TM} & \text{if project is expansion} \\ C_{GR} & \text{if project is grassroots} \end{cases}$$

Wall thickness of a vessel, t (m). P, operating Pressure (bar). Diameter, D (m). S=max stress (bar). E=weld efficiency. CA=corrosion allowance (m)

$$t = \frac{PD}{2SE - 1.2P} + CA$$

Chemical Engineering Plant Cost Index (CEPCI)

Year	CEPCI	Year	CEPCI	Year	CEPCI	Year	CEPCI
1986	318	1997	387	2008	575	2019	607
1987	324	1998	390	2009	521	2020	596
1988	343	1999	391	2010	551	2021	708
1989	355	2000	394	2011	586		
1990	358	2001	394	2012	585		
1991	361	2002	396	2013	567		
1992	358	2003	402	2014	576		
1993	359	2004	444	2015	557		
1994	368	2005	468	2016	542		
1995	381	2006	500	2017	568		
1996	382	2007	525	2018	603		

For Material of Construction information (chemical compatibility), see Table 7.9 – corrosion characteristics

Working capital can be estimated as:

$$WC = 0.1FCI_L + 0.1C_{RM} + 0.1C_{OL}$$