Sets	
S	set of suppliers (1,2…s..S)
	set of potential factories (1 . . i . I)
	set of potential warehouses (1,2..j..J)
	set of potential distribution centers (1,2..k..K)
M	set of demand markets (1 . . . m . . . M)
P	set of products (1 . . p . P)
T	set of raw materials (1 . . t . T)
Parameters	
CP_{ip}	cost of producing product p at plant I; 25*rand(F,P) + 20
CC_{st}	purchase cost of raw material t from supplier s; 15*rand(SP,P) + 10;
CB_{sit}	transportation cost of raw material t per km between supplier s and plant i ; 0.35*rand(1,P) + 1.20
CT_{ijp}	transportation cost of product p per km between plant i and warehouse j; 0.18*rand(1,P) + 1.10
CD_{jkp}	transportation cost of product p per km between warehouse j and distribution center k; 0.18*rand(1,P) + 1.10
CO_{kmp}	transportation cost of product p per km between distribution center k and demand market m ; 0.18*rand(1,P) + 1.30
E_i	fixed cost for opening plant i; ffcost= 700000*rand(F,1) + 400000
F_j	fixed cost for opening warehouse j; 30000*rand(W,1) + 40000
G_k	fixed cost for opening distribution center k; 40000*rand(DC,1) + 40000
Cas_{st} Cap_{ip}	capacity of supplier s for raw material t; 1*rand(SP,P) + 100000; capacity of plant i for product p; 20000*rand(F,P) + 75000;
Caw_{jp}	capacity of warehouse j for product p; 15000*rand(W,P) + 75000;
Cad_{kp}	capacity of distribution center k for product p; 10000*rand(DC,P) +80000
t_{si}	the distance between supplier s and plant at location i generated based on the Euclidean distance; 3*rand(SP,F) + 35.35
t_{ij}	the distance between plant at location i and warehouse at location j generated based on the Euclidean distance; 3.38*rand(F,W) + 0.18
t_{jk}	the distance between warehouse at location j and distribution center at location k generated based on the Euclidean distance; 3.38*rand(W,DC) + 0.18

t_{km}	the distance between distribution center at location k and market m generated based on the Euclidean distance; 7.31*rand(DC,S) + 0.18
$_{mp}$	demand of customer m for product p; 6000*rand(S,P) + 8000
$_{tp}$	yields of product p from raw material t; 1
F_i	environmental impact of opening plant at location i; $(Ei)^{-1}$ ×100000000000+20000
EW_j	environmental impact of opening warehouse center at location j; (Fj)-1 ×100000000000+2000
ED_k	environmental impact of opening distribution center at location k; $(Gk)^{-1}$ ×100000000000+2000
EP_i	environmental impact caused by production at plant i; (7*rand(F,P)+2)
ETS_{sit}	environmental impact per unit and per distance caused by transporting raw material t from supplier s to plant i; 3*rand(SP,F)+ 2
ETP_{ijp}	environmental impact per unit and per distance caused by transporting product p from plant i to warehouse j; 0.75*rand(F,W)+ 2
ETD_{jkp}	environmental impact per unit and per distance caused by transporting product p from warehouse j to distribution center k; 0.5*rand(W,DC)+ 2
ETW_{kmp}	environmental impact per unit and per distance caused by transporting product p from distribution center k to market m; 1.5*rand(DC,S)+ 1.5
p_{kmp}	selling price of product p transported from distribution center k at market m; 100*rand(DC,S) + 2000;
Prd_{st}	probability of delivery risk for raw material t from supplier s; 0.6*rand(SP,P)+ 0.1
Prq_{st}	probability of quality risk for raw material t from supplier s; 0.6*rand(SP,P) + 0.1
Prd_{ip}	probability of delivery risk for product p from plant i; 0.6*rand(F,P)+ 0.1
Prq_{ip}	probability of quality risk for product p produced at plant i; 0.5*rand(F,P) + 0.1
Prd_{jp}	probability of delivery risk for product p from warehouse j; 0.4*rand(W,P)+ 0.1
Prd_{kp}	probability of delivery risk for product p from distribution center k; 0.5*rand(DC,P)+ 0.1
IRD_{st}	impact caused by risk of delivery for raw material t from supplier s; 120000*rand(SP,P)+ 50000

IRQ_{st}	impact caused by risk of quality for raw material t from supplier s; 2000000*rand(SP,P) + 2200000
IRD_{ip}	impact caused by risk of delivery for product p from plant i; 70000*rand(F,P)+ 40000
IRQ_{ip}	impact caused by risk of poor quality for product p from plant i; 50000*rand(F,P) + 100000
IRD_{jp}	impact caused by risk of delivery for product p from warehouse j; 40000*rand(W,P)+ 20000
IRD_{kp}	impact caused by risk of delivery for product p from distribution center k. 50000*rand(DC,P) + 30000
Decision variables	
sit	quantity of raw material t supplied by supplier s to plant i
Y_{ijp}	quantity of product p produced at plant i shipped to warehouse centre j
jkp	quantity of product p transported from warehouse j to distribution center k
Q_{kmp}	quantity of product p transported from distribution center k to market m
X_i	1, if a plant is located and set up at potential site i, 0, otherwise
Y_j	1, if a warehouse is located and set up at potential site j, 0, otherwise
Z_k	1, if a distribution center is located and set up at potential site k, 0, otherwise
U_s	1, if a supplier s is selected, 0, otherwise

Where P is the number of products,

SP is the number of suppliers

F is the number of factories (Plants)

W is the number of warehouses

DC is the number of distribution centers

S is the number of customers