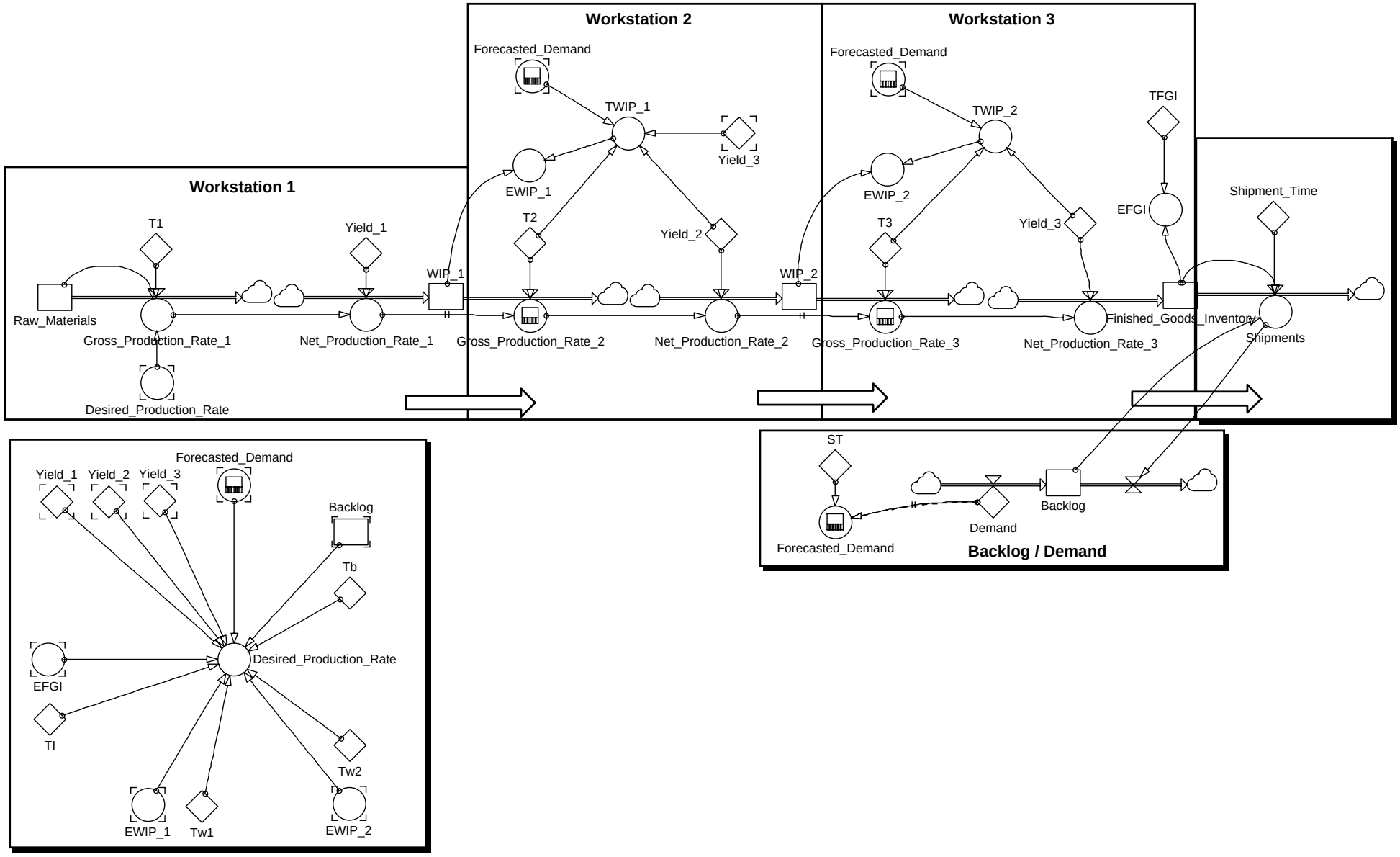
Constant Proportion Clearing Function approach



Powersim 2.5c equations for Constant Proportion Clearing Function approach

```
init    Backlog = 0
flow    Backlog = +dt*Demand -dt*Shipments
doc     Backlog = Backlogged orders in the job pool
unit    Backlog = units

init    Finished_Goods_Inventory = 31.25
flow    Finished_Goods_Inventory = +dt*Net_Production_Rate_3 -dt*Shipments
doc     Finished_Goods_Inventory = Warehouse of the finished goods
unit    Finished_Goods_Inventory = units

init    Raw_Materials = INFINITY
flow    Raw_Materials = -dt*Gross_Production_Rate_1
doc     Raw_Materials = Warehouse of raw materials. We assume infinite inventory.
unit    Raw_Materials = units

init    WIP_1 = 1
flow    WIP_1 = +dt*Net_Production_Rate_1 -dt*Gross_Production_Rate_2
doc     WIP_1 = The work in process of workstation 1
unit    WIP_1 = units

init    WIP_2 = 1
flow    WIP_2 = -dt*Gross_Production_Rate_3 +dt*Net_Production_Rate_2
doc     WIP_2 = The work in process of workstation 2
unit    WIP_2 = units

aux     Gross_Production_Rate_1 = MAX(MIN(Raw_Materials/T1,Desired_Production_Rate),0)
doc     Gross_Production_Rate_1 = Gross production rate of workstation 1
unit    Gross_Production_Rate_1 = units/time period

aux     Gross_Production_Rate_2 = DELAYMTR(Net_Production_Rate_1,T2,3,0)
doc     Gross_Production_Rate_2 = Gross production rate of workstation 2
unit    Gross_Production_Rate_2 = units/time period

aux     Gross_Production_Rate_3 = DELAYMTR(Net_Production_Rate_2,T3,3,0)
doc     Gross_Production_Rate_3 = Gross production rate of workstation 3
unit    Gross_Production_Rate_3 = units/time period

aux     Net_Production_Rate_1 = Gross_Production_Rate_1*Yield_1
doc     Net_Production_Rate_1 = Net production rate of workstation 1
unit    Net_Production_Rate_1 = units/time period

aux     Net_Production_Rate_2 = Gross_Production_Rate_2*Yield_2
doc     Net_Production_Rate_2 = Net production rate of workstation 2
unit    Net_Production_Rate_2 = units/time period

aux     Net_Production_Rate_3 = Gross_Production_Rate_3*Yield_3
doc     Net_Production_Rate_3 = Net production rate of workstation 3
unit    Net_Production_Rate_3 = units/time period
```

aux Shipments = MIN(Finished_Goods_Inventory/Shipment_Time,Backlog/Shipment_Time)
doc Shipments = Shipment rate of finished goods to the customers
unit Shipments = units/time period

aux Desired_Production_Rate = (EFGI/TI)+(EWIP_1/Tw1)+(EWIP_2/Tw2)+
(Forecasted_Demand/Yield_1/Yield_2/Yield_3)+(Backlog/Tb)
doc Desired_Production_Rate = Desired production rate defined by the order release mechanism
unit Desired_Production_Rate = units/time period

aux EFGI = TFGI-Finished_Goods_Inventory
doc EFGI = Difference between actual and target finished goods inventory
unit EFGI = units

aux EWIP_1 = TWIP_1-WIP_1
doc EWIP_1 = Difference between actual and target WIP level of workstation 1
unit EWIP_1 = units

aux EWIP_2 = TWIP_2-WIP_2
doc EWIP_2 = Difference between actual and target WIP level of workstation 2
unit EWIP_2 = units

aux Forecasted_Demand = DELAYINF(Demand,ST,1)
doc Forecasted_Demand = Demand forecast using 1st order information delay (exponential smoothing)
unit Forecasted_Demand = units/time period

aux TWIP_1 = Forecasted_Demand/Yield_2/Yield_3*T2
doc TWIP_1 = Desired WIP 1 level
unit TWIP_1 = units

aux TWIP_2 = Forecasted_Demand/Yield_3*T3
doc TWIP_2 = Desired WIP 2 level
unit TWIP_2 = units

const Demand = 31.25
doc Demand = Customer demands. We employ alternative demand patterns to examine the responsiveness
of the system.
unit Demand = units/time period

const Shipment_Time = 1
doc Shipment_Time = Time needed for finished goods to shipped to customers
unit Shipment_Time = time periods

const ST = 8
doc ST = Smoothing time used for demand forecast
unit ST = time periods

const T1 = 1
doc T1 = Manufacturing lead time of workstation 1
unit T1 = time periods

const T2 = 0.4399
doc T2 = Manufacturing lead time of workstation 2
unit T2 = time periods

const T3 = 0.4399
doc T3 = Manufacturing lead time of workstation 3
unit T3 = time periods

const Tb = 1.8798
doc Tb = It is the desired time to eliminate backlog
unit Tb = time periods

const TFGI = 0
doc TFGI = Typical target inventory
unit TFGI = units

const TI = 2
doc TI = Time to adjust actual inventory to its target level
unit TI = time periods

const Tw1 = 2
doc Tw1 = Time to adjust actual WIP1 to its target level
unit Tw1 = time periods

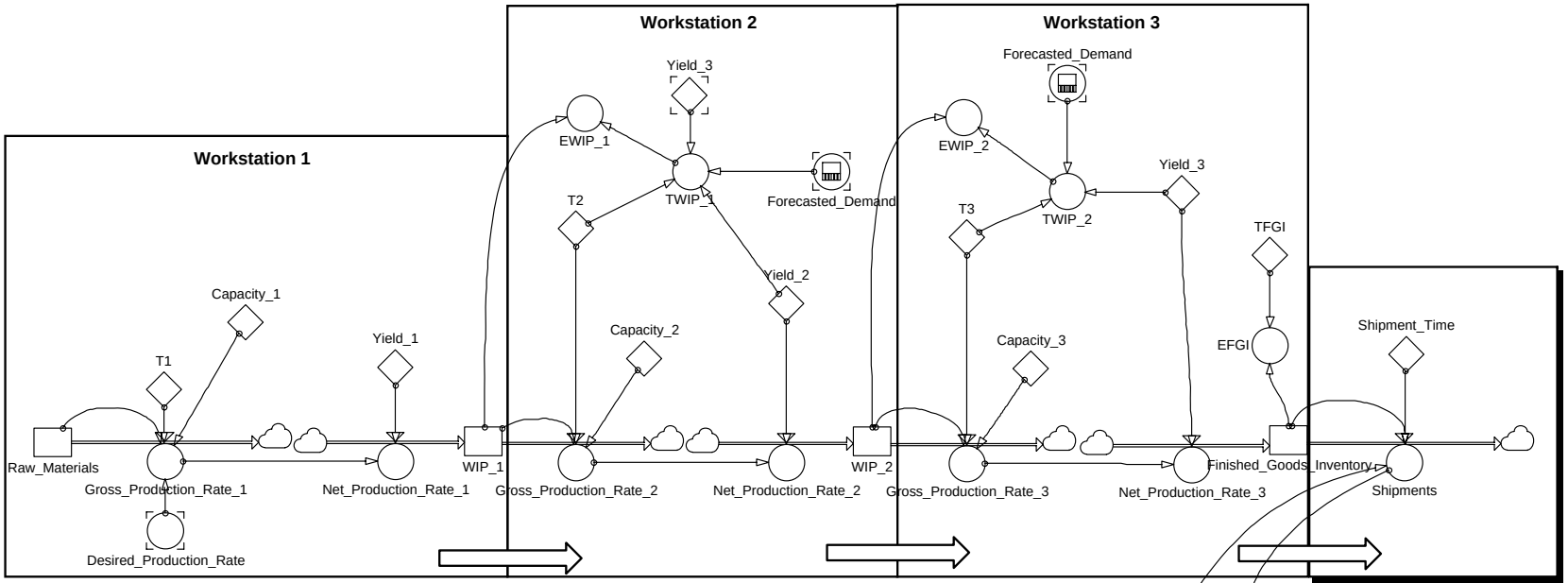
const Tw2 = 2
doc Tw2 = Time to adjust actual WIP2 to its target level
unit Tw2 = time periods

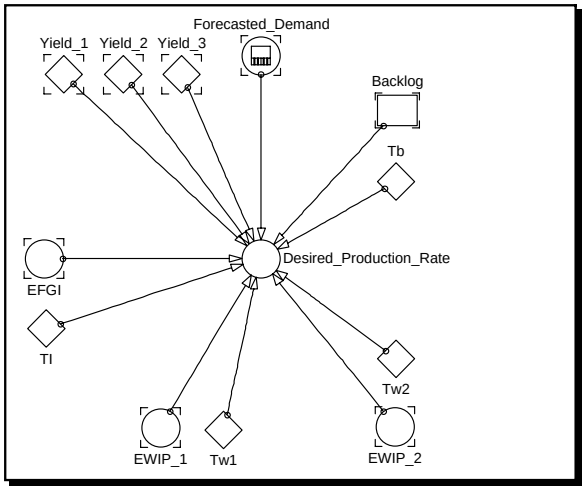
const Yield_1 = 0.87
doc Yield_1 = Yield of workstation 1
unit Yield_1 = []

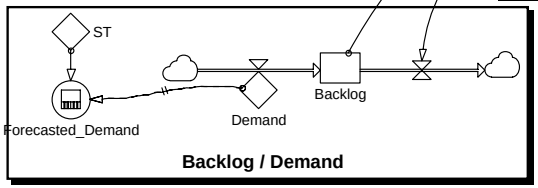
const Yield_2 = 0.90
doc Yield_2 = Yield of workstation 2
unit Yield_2 = []

const Yield_3 = 0.95
doc Yield_3 = Yield of workstation 3
unit Yield_3 = []

Capacitated Constant Proportion Clearing Function approach







Equations of Powersim 2.5c for Capacitated Constant Proportion Clearing Function approach

```
init    Backlog = 0
flow    Backlog = +dt*Demand -dt*Shipments
doc     Backlog = Backlogged orders in the job pool
unit    Backlog = units

init    Finished_Goods_Inventory = 31.25
flow    Finished_Goods_Inventory = +dt*Net_Production_Rate_3 -dt*Shipments
doc     Finished_Goods_Inventory = Warehouse of the finished goods
unit    Finished_Goods_Inventory = units

init    Raw_Materials = INFINITY
flow    Raw_Materials = -dt*Gross_Production_Rate_1
doc     Raw_Materials = Warehouse of raw materials. We assume infinite inventory.
unit    Raw_Materials = units

init    WIP_1 = 1
flow    WIP_1 = +dt*Net_Production_Rate_1 -dt*Gross_Production_Rate_2
doc     WIP_1 = The work in process of workstation 1
unit    WIP_1 = units

init    WIP_2 = 1
flow    WIP_2 = -dt*Gross_Production_Rate_3 +dt*Net_Production_Rate_2
doc     WIP_2 = The work in process of workstation 2
unit    WIP_2 = units

aux     Gross_Production_Rate_1 = MAX(MIN(Raw_Materials/T1,Desired_Production_Rate,Capacity_1),0)
doc     Gross_Production_Rate_1 = Gross production rate of workstation 1
unit    Gross_Production_Rate_1 = units/time period

aux     Gross_Production_Rate_2 = MAX(MIN(WIP_1/T2,Capacity_2),0)
doc     Gross_Production_Rate_2 = Gross production rate of workstation 2
unit    Gross_Production_Rate_2 = units/time period

aux     Gross_Production_Rate_3 = MAX(MIN(WIP_2/T3,Capacity_3),0)
doc     Gross_Production_Rate_3 = Gross production rate of workstation 3
unit    Gross_Production_Rate_3 = units/time period

aux     Net_Production_Rate_1 = Gross_Production_Rate_1*Yield_1
doc     Net_Production_Rate_1 = Net production rate of workstation 1
unit    Net_Production_Rate_1 = units/time period

aux     Net_Production_Rate_2 = Gross_Production_Rate_2*Yield_2
doc     Net_Production_Rate_2 = Net production rate of workstation 2
unit    Net_Production_Rate_2 = units/time period

aux     Net_Production_Rate_3 = Gross_Production_Rate_3*Yield_3
doc     Net_Production_Rate_3 = Net production rate of workstation 3
unit    Net_Production_Rate_3 = units/time period
```

aux Shipments = MIN(Finished_Goods_Inventory/Shipment_Time,Backlog/Shipment_Time)
doc Shipments = Shipment rate of finished goods to the customers
unit Shipments = units/time period

aux Desired_Production_Rate = (EFGI/TI)+(EWIP_1/Tw1)+(EWIP_2/Tw2)+
(Forecasted_Demand/Yield_1/Yield_2/Yield_3)+(Backlog/Tb)
doc Desired_Production_Rate = Desired production rate defined by the order release mechanism
unit Desired_Production_Rate = units/time period

aux EFGI = TFGI-Finished_Goods_Inventory
doc EFGI = Difference between actual and target finished goods inventory
unit EFGI = units

aux EWIP_1 = TWIP_1-WIP_1
doc EWIP_1 = Difference between actual and target WIP level of workstation 1
unit EWIP_1 = units

aux EWIP_2 = TWIP_2-WIP_2
doc EWIP_2 = Difference between actual and target WIP level of workstation 2
unit EWIP_2 = units

aux Forecasted_Demand = DELAYINF(Demand,ST,1)
doc Forecasted_Demand = Demand forecast using 1st order information delay (exponential smoothing)
unit Forecasted_Demand = units/time period

aux TWIP_1 = Forecasted_Demand/Yield_2/Yield_3*T2
doc TWIP_1 = Desired WIP 1 level
unit TWIP_1 = units

aux TWIP_2 = Forecasted_Demand/Yield_3*T3
doc TWIP_2 = Desired WIP 2 level
unit TWIP_2 = units

const Demand = 31.25
doc Demand = Customer demands. We employ alternative demand patterns to examine the responsiveness
of the system
unit Demand = units/time period

const Capacity_1 = 50
doc Capacity_1 = Production capacity limitation of workstation 1
unit Capacity_1 = units/time period

const Capacity_2 = 50
doc Capacity_2 = Production capacity limitation of workstation 2
unit Capacity_2 = units/time period

const Capacity_3 = 50
doc Capacity_3 = Production capacity limitation of workstation 3
unit Capacity_3 = units/time period

const Shipment_Time = 1
doc Shipment_Time = Time needed for finished goods to shipped to customers.
unit Shipment_Time = time periods

const ST = 8
doc ST = Smoothing time used for demand forecast
unit ST = time periods

const T1 = 1
doc T1 = Manufacturing lead time of workstation 1
unit T1 = time periods

const T2 = 0.5
doc T2 = Manufacturing lead time of workstation 2
unit T2 = time periods

const T3 = 0.5
doc T3 = Manufacturing lead time of workstation 3
unit T3 = time periods

const Tb = 1.8798
doc Tb = Desired time to eliminate backlog
unit Tb = time periods

const TFGI = 0
doc TFGI = Typical target inventory
unit TFGI = units

const TI = 2
doc TI = Time to adjust actual inventory to its target level
unit TI = time periods

const Tw1 = 2
doc Tw1 = Time to adjust actual WIP1 to its target level
unit Tw1 = time periods

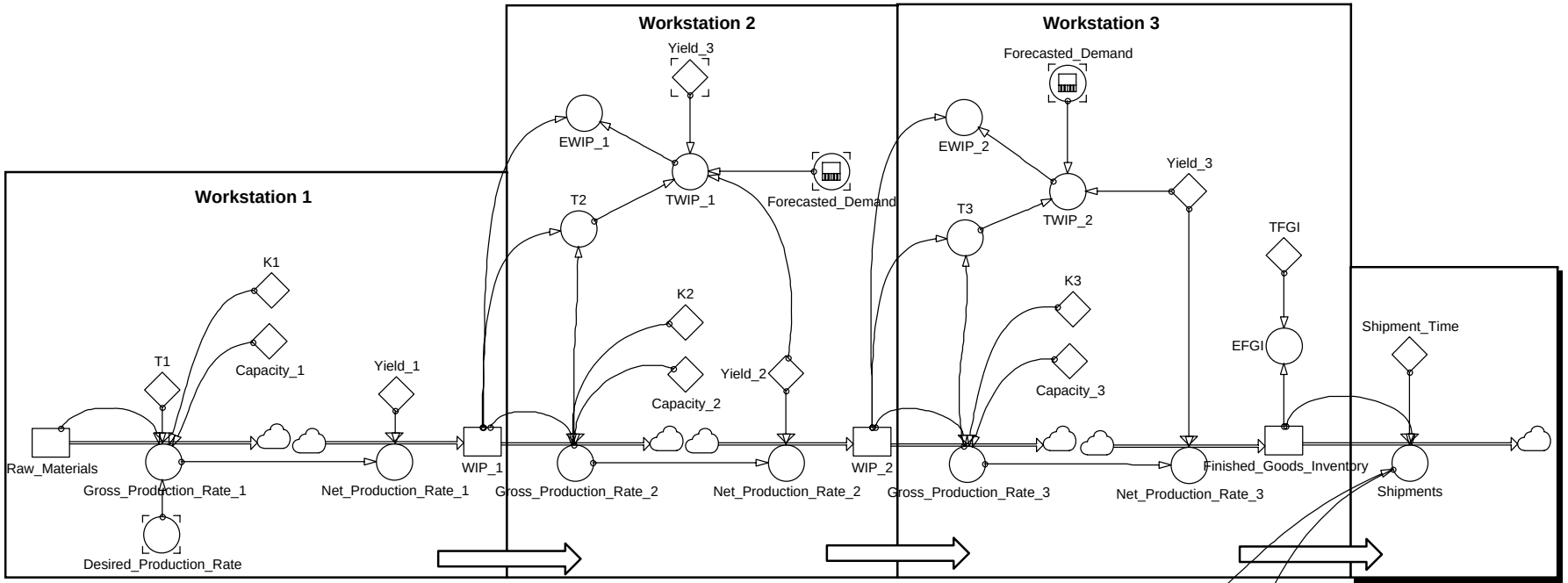
const Tw2 = 2
doc Tw2 = Time to adjust actual WIP2 to its target level
unit Tw2 = time periods

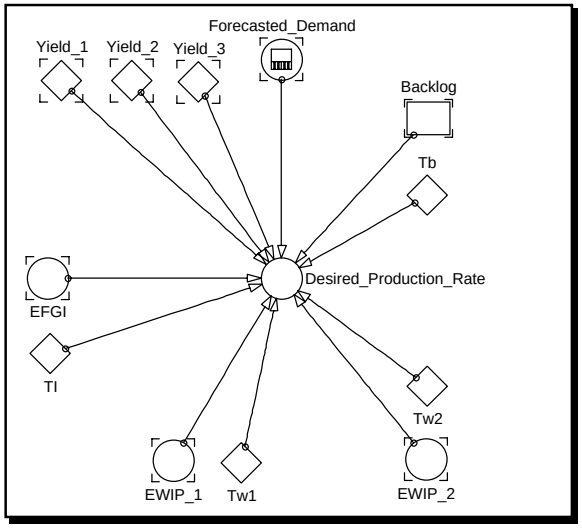
const Yield_1 = 0.87
doc Yield_1 = Yield of workstation 1
unit Yield_1 = []

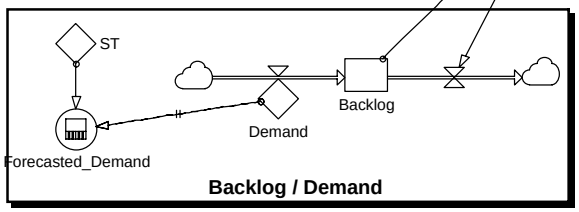
const Yield_2 = 0.90
doc Yield_2 = Yield of workstation 2
unit Yield_2 = []

const Yield_3 = 0.95
doc Yield_3 = Yield of workstation 3
unit Yield_3 = []

Concave Saturating Clearing Function approach







Powersim 2.5c equations for Concave Saturating Clearing Function approach

```
init    Backlog = 0
flow    Backlog = +dt*Demand -dt*Shipments
doc     Backlog = Backlogged orders in the job pool
unit    Backlog = units

init    Finished_Goods_Inventory = 31.25
flow    Finished_Goods_Inventory = +dt*Net_Production_Rate_3 -dt*Shipments
doc     Finished_Goods_Inventory = Warehouse of the finished goods
unit    Finished_Goods_Inventory = units

init    Raw_Materials = 1000000000000000
flow    Raw_Materials = -dt*Gross_Production_Rate_1
doc     Raw_Materials = Warehouse of raw materials. We assume infinite inventory. Thus we use a very large
        number that tends to infinity.
unit    Raw_Materials = units

init    WIP_1 = 1
flow    WIP_1 = +dt*Net_Production_Rate_1 -dt*Gross_Production_Rate_2
doc     WIP_1 = The work in process of workstation 1
unit    WIP_1 = units

init    WIP_2 = 1
flow    WIP_2 = -dt*Gross_Production_Rate_3 +dt*Net_Production_Rate_2
doc     WIP_2 = The work in process of workstation 2
unit    WIP_2 = units

aux     Gross_Production_Rate_1 = MAX(MIN(Raw_Materials/T1,Desired_Production_Rate,
        Capacity_1*Raw_Materials/(Raw_Materials+K1)),0)
doc     Gross_Production_Rate_1 = Gross production rate of workstation 1
unit    Gross_Production_Rate_1 = units/time period

aux     Gross_Production_Rate_2 = MAX(Capacity_2*WIP_1/(WIP_1+K2),0)
doc     Gross_Production_Rate_2 = Gross production rate of workstation 2
unit    Gross_Production_Rate_2 = units/time period

aux     Gross_Production_Rate_3 = MAX(Capacity_3*WIP_2/(WIP_2+K3),0)
doc     Gross_Production_Rate_3 = Gross production rate of workstation 3
unit    Gross_Production_Rate_3 = units/time period

aux     Net_Production_Rate_1 = Gross_Production_Rate_1*Yield_1
doc     Net_Production_Rate_1 = Net production rate of workstation 1
unit    Net_Production_Rate_1 = units/time period

aux     Net_Production_Rate_2 = Gross_Production_Rate_2*Yield_2
doc     Net_Production_Rate_2 = Net production rate of workstation 2
unit    Net_Production_Rate_2 = units/time period

aux     Net_Production_Rate_3 = Gross_Production_Rate_3*Yield_3
doc     Net_Production_Rate_3 = Net production rate of workstation 3
unit    Net_Production_Rate_3 = units/time period
```

aux Shipments = MIN(Finished_Goods_Inventory/Shipment_Time,Backlog/Shipment_Time)
doc Shipments = Shipment rate of finished goods to the customers
unit Shipments = units/time period

aux Desired_Production_Rate = (EFGI/TI)+(EWIP_1/Tw1)+(EWIP_2/Tw2)+
(Forecasted_Demand/Yield_1/Yield_2/Yield_3)+(Backlog/Tb)
doc Desired_Production_Rate = Desired production rate defined by the order release mechanism
unit Desired_Production_Rate = units/time period

aux EFGI = TFGI-Finished_Goods_Inventory
doc EFGI = Difference between actual and target finished goods inventory
unit EFGI = units

aux EWIP_1 = TWIP_1-WIP_1
doc EWIP_1 = Difference between actual and target WIP level of workstation 1
unit EWIP_1 = units

aux EWIP_2 = TWIP_2-WIP_2
doc EWIP_2 = Difference between actual and target WIP level of workstation 2
unit EWIP_2 = units

aux Forecasted_Demand = DELAYINF(Demand,ST,1)
doc Forecasted_Demand = Demand forecast using 1st order information delay (exponential smoothing)
unit Forecasted_Demand = units/time period

aux T2 = WIP_1/Gross_Production_Rate_2
doc T2 = Manufacturing lead time of workstation 2
unit T2 = time periods

aux T3 = WIP_2/Gross_Production_Rate_3
doc T3 = Manufacturing lead time of workstation 3
unit T3 = time periods

aux TWIP_1 = Forecasted_Demand/Yield_2/Yield_3*T2
doc TWIP_1 = Desired WIP 1 level
unit TWIP_1 = units

aux TWIP_2 = Forecasted_Demand/Yield_3*T3
doc TWIP_2 = Desired WIP 2 level
unit TWIP_2 = units

const Demand = 31.25
doc Demand = Customer demands. We employ alternative demand patterns to examine the responsiveness
of the system
unit Demand = units/time period

const Capacity_1 = 50
doc Capacity_1 = Production capacity limitation of workstation 1
unit Capacity_1 = units/time period

const Capacity_2 = 50
doc Capacity_2 = Production capacity limitation of workstation 2
unit Capacity_2 = units/time period

const Capacity_3 = 50
doc Capacity_3 = Production capacity limitation of workstation 3
unit Capacity_3 = units/time period

const K1 = 7.55
doc K1 = Parameter that defines the curvature of the clearing function for workstation 1
unit K1 = []

const K2 = 7.55
doc K2 = Parameter that defines the curvature of the clearing function for workstation 2
unit K2 = []

const K3 = 7.55
doc K3 = Parameter that defines the curvature of the clearing function for workstation 3
unit K3 = []

const Shipment_Time = 1
doc Shipment_Time = Time needed for finished goods to shipped to customers
unit Shipment_Time = time periods

const ST = 8
doc ST = Smoothing time used for demand forecast
unit ST = time periods

const T1 = 1
doc T1 = Manufacturing lead time of workstation 1
unit T1 = time periods

const Tb = 1.8798
doc Tb = Desired time to eliminate backlog
unit Tb = time periods

const TFGI = 0
doc TFGI = Typical target inventory
unit TFGI = units

const TI = 2
doc TI = Time to adjust actual inventory to its target level
unit TI = time periods

const Tw1 = 2
doc Tw1 = Time to adjust actual WIP1 to its target level
unit Tw1 = time periods

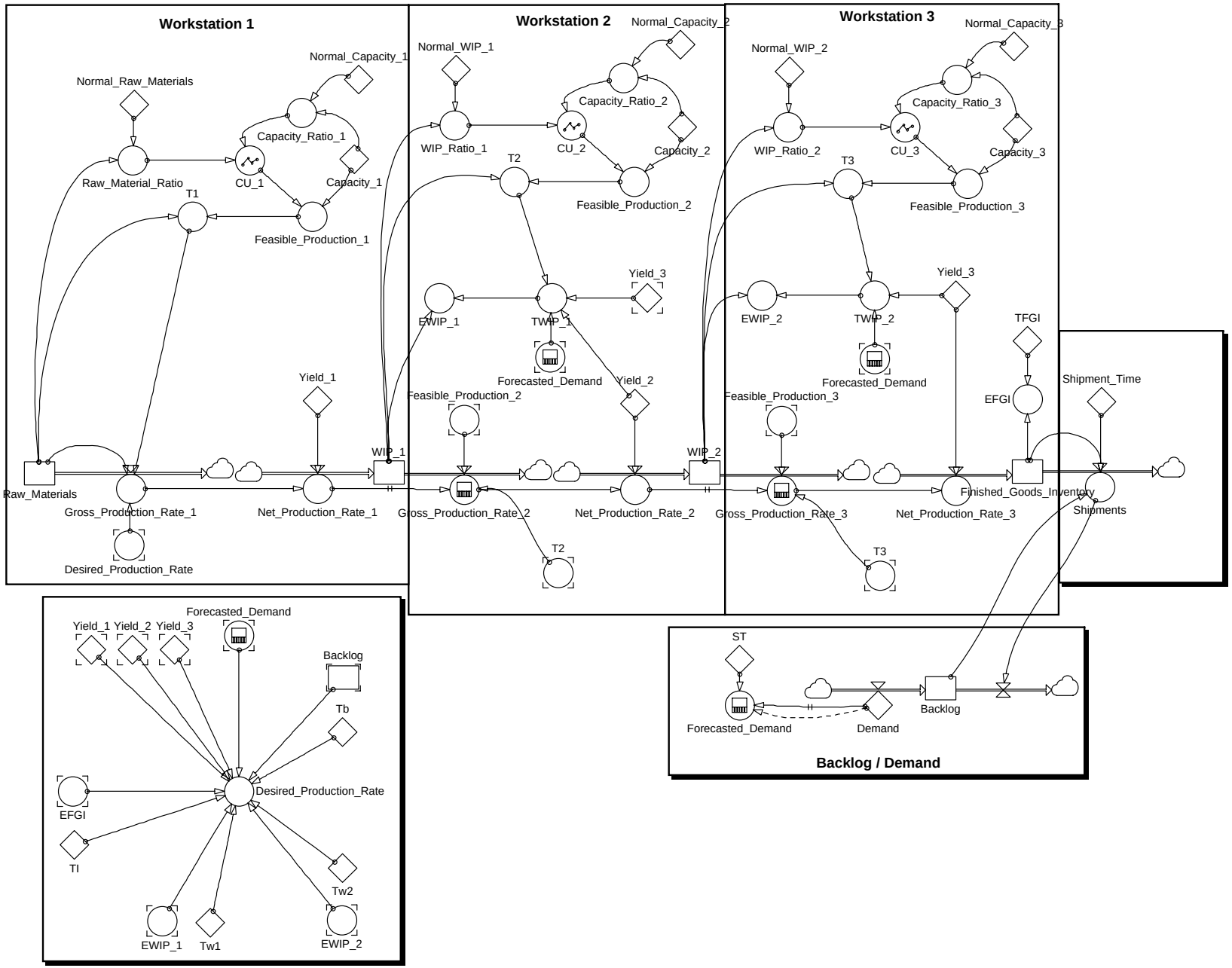
const Tw2 = 2
doc Tw2 = Time to adjust actual WIP2 to its target level
unit Tw2 = time periods

const Yield_1 = 0.87
doc Yield_1 = Yield of workstation 1
unit Yield_1 = []

```
const   Yield_2 = 0.90
doc     Yield_2 = Yield of workstation 2
unit    Yield_2 = []

const   Yield_3 = 0.95
doc     Yield_3 = Yield of workstation 3
unit    Yield_3 = []
```

Variable Capacity utilization approach



Equations of Powersim 2.5c for Variable Capacity utilization approach

init Backlog = 0
flow Backlog = +dt*Demand -dt*Shipments
doc Backlog = Backlogged orders in the job pool
unit Backlog = units

init Finished_Goods_Inventory = 31.25
flow Finished_Goods_Inventory = +dt*Net_Production_Rate_3 -dt*Shipments
doc Finished_Goods_Inventory = Warehouse of the finished goods
unit Finished_Goods_Inventory = units

init Raw_Materials = 1000000000000000
flow Raw_Materials = -dt*Gross_Production_Rate_1
doc Raw_Materials = Warehouse of raw materials. We assume infinite inventory. Thus we use a very large number that tends to infinity
unit Raw_Materials = units

init WIP_1 = 1
flow WIP_1 = +dt*Net_Production_Rate_1 -dt*Gross_Production_Rate_2
doc WIP_1 = The work in process of workstation 1
unit WIP_1 = units

init WIP_2 = 1
flow WIP_2 = -dt*Gross_Production_Rate_3
+dt*Net_Production_Rate_2
doc WIP_2 = The work in process of workstation 2
unit WIP_2 = units

aux Gross_Production_Rate_1 = MAX(MIN(Raw_Materials/T1,Desired_Production_Rate),0)
doc Gross_Production_Rate_1 = Gross production rate of workstation 1
unit Gross_Production_Rate_1 = units/time period

aux Gross_Production_Rate_2 = MAX(MIN(DELAYMTR(Net_Production_Rate_1,T2/n,n,0),
Feasible_Production_2),0)*
doc Gross_Production_Rate_2 = Gross production rate of workstation 2
unit Gross_Production_Rate_2 = units/time period

aux Gross_Production_Rate_3 = MAX(MIN(DELAYMTR(Net_Production_Rate_2,T3/n,n,0),
Feasible_Production_3),0)*
doc Gross_Production_Rate_3 = Gross production rate of workstation 3
unit Gross_Production_Rate_3 = units/time period

aux Net_Production_Rate_1 = Gross_Production_Rate_1*Yield_1
doc Net_Production_Rate_1 = Net production rate of workstation 1
unit Net_Production_Rate_1 = units/time period

aux Net_Production_Rate_2 = Gross_Production_Rate_2*Yield_2
doc Net_Production_Rate_2 = Net production rate of workstation 2
unit Net_Production_Rate_2 = units/time period

**. n=1 for 1-VC approach, and n=3 for 3-VC approach*

```
aux     Net_Production_Rate_3 = Gross_Production_Rate_3*Yield_3
doc     Net_Production_Rate_3 = Net production rate of workstation 3
unit    Net_Production_Rate_3 = units/time period

aux     Shipments = MIN(Finished_Goods_Inventory/Shipment_Time,Backlog/Shipment_Time)
doc     Shipments = Shipments rate of finished goods to the customers
unit    Shipments = units/time period

aux     Capacity_Ratio_1 = Capacity_1/Normal_Capacity_1
doc     Capacity_Ratio_1 = Workstation's 1 ratio of actual Capacity to the Normal Capacity
unit    Capacity_Ratio_1 = []

aux     Capacity_Ratio_2 = Capacity_2/Normal_Capacity_2
doc     Capacity_Ratio_2 = Workstation's 2 ratio of actual Capacity to the Normal Capacity
unit    Capacity_Ratio_2 = []

aux     Capacity_Ratio_3 = Capacity_3/Normal_Capacity_3
doc     Capacity_Ratio_3 = Workstation's 3 ratio of actual Capacity to the Normal Capacity
unit    Capacity_Ratio_3 = []

aux     CU_1 = GRAPH(Raw_Material_Ratio/Capacity_Ratio_1,
        0,0.1,[0,0.29,0.5,0.65,0.78,0.87,0.93,0.97,0.99,1,1"Min:0;Max:1"])
doc     CU_1 = Capacity utilization of workstation 1
unit    CU_1 = []

aux     CU_2 = GRAPH(WIP_Ratio_1/Capacity_Ratio_2,
        0,0.1,[0,0.29,0.5,0.65,0.78,0.87,0.93,0.97,0.99,1,1"Min:0;Max:1"])
doc     CU_2 = Capacity utilization of workstation 2
unit    CU_2 = []

aux     CU_3 = GRAPH(WIP_Ratio_2/Capacity_Ratio_3,
        0,0.1,[0,0.29,0.5,0.65,0.78,0.87,0.93,0.97,0.99,1,1"Min:0;Max:1"])
doc     CU_3 = Capacity utilization of workstation 1
unit    CU_3 = []

aux     Desired_Production_Rate = (EFGI/TI)+(EWIP_1/Tw1)+(EWIP_2/Tw2)+
        (Forecasted_Demand/Yield_1/Yield_2/Yield_3)+(Backlog/Tb)
doc     Desired_Production_Rate = Desired production rate defined by the order release mechanism
unit    Desired_Production_Rate = units/time period

aux     EFGI = TFGI-Finished_Goods_Inventory
doc     EFGI = Difference between actual and target finished goods inventory
unit    EFGI = units

aux     EWIP_1 = TWIP_1-WIP_1
doc     EWIP_1 = Difference between actual and target WIP level of workstation 1
unit    EWIP_1 = units

aux     EWIP_2 = TWIP_2-WIP_2
doc     EWIP_2 = Difference between actual and target WIP level of workstation 2
unit    EWIP_2 = units
```

aux Feasible_Production_1 = Capacity_1*CU_1
doc Feasible_Production_1 = It is the product of Capacity and Capacity utilization of workstation 1
unit Feasible_Production_1 = units/time period

aux Feasible_Production_2 = Capacity_2*CU_2
doc Feasible_Production_2 = It is the product of Capacity and Capacity utilization of workstation 2
unit Feasible_Production_2 = units/time period

aux Feasible_Production_3 = Capacity_3*CU_3
doc Feasible_Production_3 = It is the product of Capacity and Capacity utilization of workstation 3
unit Feasible_Production_3 = units/time period

aux Forecasted_Demand = DELAYINF(Demand,ST,1)
doc Forecasted_Demand = Demand forecast using 1st order information delay (exponential smoothing)
unit Forecasted_Demand = units/time period

aux Raw_Material_Ratio = Raw_Materials/Normal_Raw_Material
doc Raw_Material_Ratio = Ratio of actual Raw Materials inventory to the Normal Raw Materials Inventory
unit Raw_Material_Ratio = []

aux T1 = MAX(Raw_Materials/Feasible_Production_1,0.06)
doc T1 = Manufacturing lead time of workstation 1. T1 is used as the delay time for Gross_Production_Rate_1. The 0.06 limitation is due to the order of delay. (dT<T/2n)
unit T1 = time periods

aux T2 = MAX(WIP_1/Feasible_Production_2,0.06)
doc T2 = Manufacturing lead time of workstation 2. T2 is used as the delay time for Gross_Production_Rate_1. The 0.06 limitation is due to the order of delay. (dT<T/2n)
unit T2 = time periods

aux T3 = MAX(WIP_2/Feasible_Production_3,0.06)
doc T3 = Manufacturing lead time of workstation 3. T3 is used as the delay time for Gross_Production_Rate_1. The 0.06 limitation is due to the order of delay. (dT<T/2n)
unit T3 = time periods

aux TWIP_1 = Forecasted_Demand/Yield_2/Yield_3*T2
doc TWIP_1 = Desired WIP 1 level
unit TWIP_1 = units

aux TWIP_2 = Forecasted_Demand/Yield_3*T3
doc TWIP_2 = Desired WIP 2 level
unit TWIP_2 = units

aux WIP_Ratio_1 = WIP_1/Normal_WIP_1
doc WIP_Ratio_1 = Ratio of actual WIP1 level to the Normal WIP1 level
unit WIP_Ratio_1 = []

aux WIP_Ratio_2 = WIP_2/Normal_WIP_2
doc WIP_Ratio_2 = Ratio of actual WIP2 level to the Normal WIP2 level
unit WIP_Ratio_2 = []

const Demand = 31.25
doc Demand = Customer demands. We employ alternative demand patterns to examine the responsiveness of the system
unit Demand = units/time period
const Capacity_1 = 50
doc Capacity_1 = Production capacity limitation of workstation 1
unit Capacity_1 = units/time period

const Capacity_2 = 50
doc Capacity_2 = Production capacity limitation of workstation 2
unit Capacity_2 = units/time period

const Capacity_3 = 50
doc Capacity_3 = Production capacity limitation of workstation 3
unit Capacity_3 = units/time period

const Normal_Capacity_1 = 50
doc Normal_Capacity_1 = Workstation's 1 normal production capacity
unit Normal_Capacity_1 = units/time period

const Normal_Capacity_2 = 50
doc Normal_Capacity_2 = Workstation's 2 normal production capacity
unit Normal_Capacity_2 = units/time period

const Normal_Capacity_3 = 50
doc Normal_Capacity_3 = Workstation's 3 normal production capacity
unit Normal_Capacity_3 = units/time period

const Normal_Raw_Material = 100000000000
doc Normal_Raw_Material = Raw Materials normal inventory. It is a very large number which tends to infinity.
unit Normal_Raw_Material = units

const Normal_WIP_1 = 51.7
doc Normal_WIP_1 = Workstation's 1 normal work in process level
unit Normal_WIP_1 = units

const Normal_WIP_2 = 51.7
doc Normal_WIP_2 = Workstation's 2 normal production capacity
unit Normal_WIP_2 = units

const Shipment_Time = 1
doc Shipment_Time = Time needed for finished goods to shipped to customers.
unit Shipment_Time = time periods

const ST = 8
doc ST = Smoothing time used for demand forecast
unit ST = time periods

const Tb = 1.8798
doc Tb = Desired time to eliminate backlog
unit Tb = time periods

```
const   TFGI = 0
doc     TFGI = Typical target inventory
unit    TFGI = units

const   TI = 2
doc     TI = Time to adjust actual inventory to its target level
unit    TI = time periods

const   Tw1 = 2
doc     Tw1 = Time to adjust actual WIP1 to its target level
unit    Tw1 = time periods

const   Tw2 = 2
doc     Tw2 = Time to adjust actual WIP2 to its target level
unit    Tw2 = time periods

const   Yield_1 = 0.87
doc     Yield_1 = Yield of workstation 1
unit    Yield_1 = []

const   Yield_2 = 0.90
doc     Yield_2 = Yield of workstation 2
unit    Yield_2 = []

const   Yield_3 = 0.95
doc     Yield_3 = Yield of workstation 3
unit    Yield_3 = []
```