The Good, the Bad and the Mediocre: Creating Insightful Stories on Process Improvement

Supplementary file

Model equations

perceived delivery dependability =
  SMOOTH((throughput time competitors)/throughput time, ST market,
  ,INI perceived delivery dependability)
  ~ Dmnl
  ~

perceived quality level =
  SMOOTH(quality level/(quality level competitors), ST market,
  ,INI perceived quality level)
  ~ Dmnl
  ~

perceived price level =
  SMOOTH(price/(price level competitors), ST market, INI price level)
  ~ Dmnl
  ~

management's program commitment =
  SMOOTH((E perceived financial effort on commitment + E improvement results on commitment
  )/2, ST management's commitment)
  ~ Dmnl
  ~

Perceived financial effort for process improvement =
  XIDZ(expenses for process improvement, (revenues-expenses), expenses for process improvement/
  1e-012)
  ~ Dmnl
  ~

E perceived financial effort on commitment =
  T E perceived financial effort on commitment(Perceived financial effort for process improvement
  )
  ~ Dmnl
  ~

T E perceived financial effort on commitment(
  [(-1,0)-(1,1)], (-1,0), (0,0), (0,1), (0,1,1), (0,2,0.75), (0,3,0.5), (0,4,0.25), (0,5,0.125),
  (0,6,0.075), (0,7,0.0375), (0,8,0.01875), (0,9,0))
  ~
  ~

expenses for process improvement =
  budget for improvements/days per year
  ~ €/Day
  ~

ST management's commitment =
  360
INI price level =
1

budget for improvements = GAME (normal budget for improvements)

accumulated profits = INTEG (revenues - expenses - expenses for process improvement - expenses for process improvement, INI finanzielle mittel)

INI fraction of accumulated profits for process improvements = 0.1

normal budget for improvements = INITIAL(INI finanzielle mittel * INI fraction of accumulated profits for process improvements)

expected results processes' quality = workers' effort in process improvement * LN(2) * INI likelihood of defects introduction / "expected half-life time"

expected results quality control = workers' effort in process improvement * LN(2) * INI quality control / "expected half-life time"

expected results processing time = workers' effort in process improvement * LN(2) * INI processing time / "expected half-life time"

TE improvement results on commitment:
[(0,0)-(2,1.5)],(0,0.25),(0.5,0.5),(1,1),(1.5,1.25),(2,1.5)

average salaries =
2500

perceived improvement results = (perceived results workers' productivity + perceived results machinery down time + perceived results processing time + perceived results suppliers' quality + perceived results processes' quality + perceived results quality control) / 6
"max. likelihood of defects introduction" = 0.4
expected results machinery down time = workers' effort in process improvement * LN(2) * INI machinery down time / "expected half-life time"
perceived results machinery down time = improvements in machinery down time / expected results machinery down time
perceived results processes' quality = improvements in likelihood of defects introduction / expected results processes' quality
perceived results processes' quality = improvements in likelihood of defects introduction / expected results processes' quality
expected results suppliers' quality = workers' effort in process improvement * LN(2) * INI fraction of defects from suppliers / "expected half-life time"
"expected half-life time" = 200
perceived results suppliers' quality = improvements in quality control / expected results quality control
E improvement results on commitment = T E improvement results on commitment (perceived improvement results)
perceived results suppliers' quality = improvements in suppliers' quality/expected results suppliers' quality
~ Dmnl

capital unit costs = 
(KAPITALKOSTEN + perceived inventory turnover * INTERNER ZINSSATZ * material costs)/net production rate
~ €/Unit

unit costs = 
(unit labor costs + material costs + capital unit costs)
~ €/Unit

unit labor costs = 
average salaries/days per month * workforce/net production rate
~ €/Unit

focus machinery down time = GAME (INJ effort for machinery down time/SUM INJ improvement effort)
~ Dmnl

focus quality control = GAME (INJ effort quality control/SUM INJ improvement effort)
~ Dmnl

gains in worker productivity = 
("max. worker productivity" - worker productivity) * LN(2) * workers' effort in process improvement
* effort worker productivity
/"half-life time worker productivity"
~ Unit/(Worker*Day*Day)

improvements in processing time = 
(processing time - "min. processing time") * LN(2) /"half-life time processing time" * workers' effort in process improvement
* effort processing time
~ Day/Day

improvements in likelihood of defects introduction = 
(likelihood of defects introduction - "min. likelihood of defects introduction") * LN(2)
/"half-life time likelihood of defects introduction"
* effort for likelihood of defects introduction * workers' effort in process improvement
~ Dmnl/Day

improvements in suppliers' quality = 
(fraction of defects from suppliers - "min. fraction of defects from suppliers"
)/"half-life time fraction of defects from suppliers" * LN(2) * workers' effort in process improvement
* effort fraction of defects from suppliers
~ Dmnl/Day

improvements in machinery down time =
LN(2)*(machinery down time-"min. machinery down time")/"half-life time machinery down time"
*effort for machinery down time
*workers' effort in process improvement
~ Dmnl/Day
~ |
improvements in quality control=
("max. quality control"-quality control)*LN(2)*workers' effort in process improvement
*effort quality control
/"half-life time quality control"
~ Dmnl/Day
~ |
effort for machinery down time=
focus machinery down time*SUM INI improvement effort
~ Dmnl
~ |
effort quality control=
focus quality control*SUM INI improvement effort
~ Dmnl
~ |
focus processing time= GAME (INI effort processing time/SUM INI improvement effort)
~ Dmnl
~ |
focus worker productivity= GAME (INI effort worker productivity/SUM INI improvement effort)
~ Dmnl
~ |
focus likelihood of defects introduction= GAME (INI effort for likelihood of defects introduction/SUM INI improvement effort)
~ Dmnl
~ |
effort for likelihood of defects introduction=
focus likelihood of defects introduction*SUM INI improvement effort
~ Dmnl
~ |
focus on fraction of defects from suppliers= GAME (INI effort fraction of defects from suppliers/SUM INI improvement effort)
~ Dmnl
~ |
effort worker productivity=
focus worker productivity*SUM INI improvement effort
~ Dmnl
~ |
effort processing time=
focus processing time*SUM INI improvement effort
~ Dmnl
~ |
effort fraction of defects from suppliers=
focus on fraction of defects from suppliers*SUM INI improvement effort
~ Dmnl
~ |
likelihood of defects introduction = INTEG ( 
deteriorations in likelihood of defects introduction - improvements in likelihood of defects introduction \\
, 
INI likelihood of defects introduction) 
~ Dmnl 
~ 
"max. processing time" = 
3 
~ Day 
~ 
quality control = INTEG ( 
deteriorations in quality control + improvements in quality control, 
INI quality control) 
~ Dmnl 
~ 
deteriorations in suppliers' quality = 
("max. fraction of defects from suppliers" - fraction of defects from suppliers 
)*LN(2)/ET fraction of defects from suppliers 
~ Dmnl/Day 
~ 
"max. machinery down time" = 
0.2 
~ Dmnl 
~ 
SUM INI improvement effort = INITIAL( 
INI effort worker productivity + INI effort for likelihood of defects introduction + INI effort processing time \\
+ INI effort fraction of defects from suppliers + INI effort for machinery down time + INI effort quality control 
) 
~ Dmnl 
~ 
fraction of defects from suppliers = INTEG ( 
deteriorations in suppliers' quality - improvements in suppliers' quality, 
INI fraction of defects from suppliers) 
~ Dmnl 
~ 
machinery down time = INTEG ( 
-improvements in machinery down time + deteriorations in machinery down time, 
INI machinery down time) 
~ Dmnl 
~ 
worker productivity = INTEG ( 
-loses in worker productivity + gains in worker productivity, 
INI worker productivity) 
~ Unit/(Worker*Day) 
~ 
INI effort for likelihood of defects introduction = INITIAL( 
(LN(2)/ET likelihood of defects introduction)*("max. likelihood of defects introduction" \\
- INI likelihood of defects introduction)/((workers' effort in process improvement 
*(LN(2)/"half-life time likelihood of defects introduction")*(INI likelihood of defects introduction \\
- "min. likelihood of defects introduction")
INI effort processing time = INITIAL(
    (LN(2)/ET processing time)*"max. processing time"-INI processing time)/(workers' effort in process improvement:
        *(LN(2)/"half-life time processing time")*(INI processing time-"min. processing time"
    ))
~ Dmnl
~

INI effort fraction of defects from suppliers = INITIAL(
    (LN(2)/ET fraction of defects from suppliers)*"max. fraction of defects from suppliers"
    -INI fraction of defects from suppliers
    )/"half-life time fraction of defects from suppliers"
~ Dmnl
~

INI effort for machinery down time = INITIAL(
    (LN(2)/ET machinery down time)*"max. machinery down time"-INI machinery down time
    )/"half-life time machinery down time"
~ Dmnl
~

INI effort quality control = INITIAL(
    (INI quality control-MINIMALER ANTEIL FEHLERENTDECKUNG)*LN(2)/ET quality control/
    "half-life time quality control")
~ Dmnl
~
deteriorations in likelihood of defects introduction =
    ("max. likelihood of defects introduction"-likelihood of defects introduction)*LN(2):
    /ET likelihood of defects introduction
~ Dmnl/Day
~
deteriorations in machinery down time =
    ("max. machinery down time"-machinery down time)*LN(2)/ET machinery down time
~ Dmnl/Day
~

"max. fraction of defects from suppliers" = 0.4
~ Dmnl
~

GAME INTERVAL =
    GAME(30)
~ Day
~

program commitment workers = INTEG (
(change in workers' commitment + E management on workers' commitment),
INI workers' commitment)

~ Dmnl

"min. worker productivity" :=
~ 8
~ Unit/(Day*Worker)
~

MINIMALER ANTEIL FEHLERENTDECKUNG =
0.8
~ Dmnl
~

processing time = INTEG(
  deteriorations in processing time - improvements in processing time,
  INI processing time)
~ Day
~

deteriorations in quality control =
  (quality control - MINIMALER ANTEIL FEHLERENTDECKUNG)*LN(2)/ET quality control
~ Dmnl/Day
~

loses in worker productivity =
  (worker productivity - "min. worker productivity")*LN(2)/ET worker productivity
~ Unit/(Worker*Day*Day)
~

ET machinery down time =
1080
~ Day
~

INI effort worker productivity = INITIAL(
  (INI worker productivity - "min. worker productivity")*LN(2)/ET worker productivity/
  "max. worker productivity"
  -INI worker productivity)*LN(2)*workers' effort in process improvement
 ="/half-life time worker productivity")
~ Dmnl
~

deteriorations in processing time =
  ("max. processing time" - processing time)*LN(2)/ET processing time
~ Day/Day
~

INI workers' commitment = INITIAL(
0.786821)
~ Dmnl
~

machinery capacity =
10000*(1 - machinery down time)
~ Unit/Day
~

TE market share on margin(
[(0,0)-(2,2)],(2,2),(1.3,2),(1.2,1.75),(1.1,1.5),(1.05,1.1),(1,1),(0.95,0.9),(0.9,0.5,
),(0.8,0.25),(0.7,0),(0,0))
E market share on margin =
(T E market share on margin \( \text{market share/desired market share} \))

price =
SMOOTH(unit costs \( \times (1 + \text{desired margin} \times E \text{market share on margin}) \), \( \text{AT price} \))

desired market share =
INI traditional market share

decline in memories in lay offs =
perceived job security/ST forgetting lay offs

willingness to hire =
GAME(1)

INI experience level =
"averg. experiences new recruits\(^*\text{hiring} + \) on the job experiences/(1/\text{DT forgetting time experiences} + 1/\text{work force}(\text{laying off} + \text{fluctuation} + \text{on the job experiences} / \text{max. averag. experience level} /))"

fraction of workers' productivity for training =
(1 - training effort - fraction of training effort)

INI workers' productivity =
10

INI perceived quality level =
1

INI perceived delivery dependability =
1

fraction of training effort =
"max. fraction working day for improvements\(^*\text{program commitment workers}"

INI training level =
"averg. training new recruits\(^*\text{hiring} + \text{intensity of training} \times \text{work force}/(1/\text{DT forgetting time training})"
+1/work force*(fluctuation+laying off)+intensity of training/"max. averag. training level"

~  Hour

workers' effort in process improvement=
  "averag. improvement capabilities worker"*program commitment workers
  ~  Dmnl
  

~  Dmnl

~  Hour/Day

~  Hour/Day

~  Hour/(Day*Worker)

~  Hour/Worker/Day

~  Dmnl

~  Dmnl

~  €/Day

E commitment on gains in commitment
  T E commitment on gains in commitment(program commitment workers)
  ~  Dmnl

~  Dmnl

~  Unit/Day

~  Hour/Day

~  €/Day

~  Hour/Day

~  Hour/Worker/Day

~  Unit/Day

~  Unit/Day

~  €/Day

~  Hour/Day

~  Hour/Day

T effekt arbeitsplatzsicherheit auf commitment(
  [(0,-1)-(0.1,0)],(0,0),(0.0075,-0.35),(0.02,-0.6),(0.035,-0.825),(0.06,-0.95),(0.07,-0.975),(0.09,-1),(0.1,-1))

~  Dmnl

~  Dmnl

T E commitment on gains in commitment(}
T.E. price on market share

\[
[(0.75,0)-(1.25,1.6),(0.75,1.6),(0.85,1.4),(0.85,1.25),(0.9,1.15),(0.95,1.05),(1,1),
(1.05,0.95),(1.1,0.85),(1.15,0.75),(1.2,0.6),(1.25,0.4)]
\]

\[\sim \]  Dmnl

\[\sim \]  

Gross production rate =

\[
\min(\text{production capacity}, \frac{\text{WIP}}{\text{processing time}})
\]

\[\sim \]  Unit/Day

Fluctuation =

\[
\frac{\text{work force}}{\text{DT membership}}
\]

\[\sim \]  Worker/Day

Market share =

\[
E \text{ quality on market share} \times E \text{ price on market share} \times E \text{ delivery dependability on market share} \times \text{traditional market share}
\]

\[\sim \]  Dmnl

Training effort =

\[
\text{intensity of training} \times \text{work day}
\]

\[\sim \]  Dmnl

Throughput time =

\[
\frac{\text{backlog}}{\text{net production rate}}
\]

\[\sim \]  Day

Throughput time competitors = INITIAL(

\[\sim \]  Day

"Average lay offs" =

\[
\frac{\text{laying off}}{\text{work force}}
\]

\[\sim \]  Dmnl/Day

DT membership =

\[
7200
\]

\[\sim \]  Day

"Average improvement capabilities worker" =

\[
E \text{ experiences on improvement capabilities} \times \frac{\text{averag. training level}}{\text{max. averag. training level}} + E \text{ training on improvement capabilities} \times \frac{\text{averag. experiences}}{\text{max. averag. experience level}}
\]

\[\sim \]  Dmnl

Average experiences =

\[
\frac{\text{workers' experiences}}{\text{work force}}
\]

\[\sim \]  Hour/Worker
"averag. experiences new recruits"=
0.1
~ Hour/Worker

"averag. training level"=
workers' training level/work force
~ Hour/Worker

"averag. training new recruits"=
0.1
~ Hour/Worker

E delivery dependability on market share=
TE delivery dependability on market share(perceived delivery dependability)
~ Dmnl

E management support=
TE management support(desired management support/management support)
~ Dmnl

E quality on market share=
TE quality on market share(perceived quality level)
~ Dmnl

E perceived job security on commitment=
TE effekt arbeitsplatzsicherheit auf commitment(perceived job security)
~ Dmnl

perceived fluctuation=
SMOOTH(fluctuation, ST fluctuation)
~ Worker/Day

E experiences on gain in experiences=
MAX(1-"averag. experiences"/"max. averag. experience level",0)
~ Dmnl

E price on market share=
TE price on market share(perceived price level)
~ Dmnl

E training on gain in training=
MAX(1-"averag. training level"/"max. averag. training level",0)
~ Dmnl

E management on workers' commitment=
(management's program commitment-program commitment workers)/days per year
~ Dmnl/Day
E experiences on improvement capabilities =
  0.2
  \sim Dmnl
  \sim

E training on improvement capabilities =
  0.8
  \sim Dmnl
  \sim

increase in memories in layoffs =
  \text{MAX}("average. layoffs"-perceived job security, 0 )/ST memories layoffs
  \sim Dmnl/(\text{Day} \times \text{Day})
  \sim

hiring =
  willingness to hire*\text{MAX}(\text{Workerlücke}/\text{EINSTELLUNGVERZÖGERUNGSZEIT} + \text{perceived fluctuation})\null
  \sim \text{Worker}/\text{Day}
  \sim

\text{EINSTELLUNGVERZÖGERUNGSZEIT} =
  90
  \sim \text{Day}
  \sim

laying off =
  willingness to lay off*\text{MAX}(\text{Workerlücke}*(-1),0)/\text{DT laying off}
  \sim \text{Worker}/\text{Day}
  \sim

willingness to lay off =
  \text{GAME}(1)
  \sim Dmnl
  \sim

\text{DT laying off} =
  90
  \sim \text{Day}
  \sim

on the job experiences =
  work force*program commitment workers*work day*"max. fraction working day for improvements"
  \sim \text{Hour}/\text{Day}
  \sim

workers' experiences = \text{INTEG} ( gains in experience through hiring+gains in experience-loses in experience from fluctuation and laying off-
  loses in experiences from forgetting,
  \text{INI experience level})
  \sim \text{Hour}
  \sim

loses in experience from fluctuation and laying off =
  "averag. experiences"*(laying off+fluctuation)
  \sim \text{Hour}/\text{Day}
  \sim

loses in experiences from forgetting =
  workers' experiences/\text{DT forgetting time experiences}
gains in experience = E experiences on gain in experiences*on the job experiences
perceived job security = INTEG (+increase in memories in lay offs-decline in memories in lay offs, laying off/work force)
DT forgetting time training = 1800
perceived inventory turnover = SMOOTH(inventory turnover, ST perceived inventory turnover)
work force = INTEG (hiring-laying off-fluctuation, desired work force)
intensity of training = management's training goal*"max. averag. training level"/days per year
T E delivery dependability on market share( [(0,0.0)-(2,1)],[(0,0.4),(0.3,0.425),(0.575,0.525),(0.8,0.7),(0.9,0.9),(1,1),(2,1)] )
T E management support( [(0,-1)-(2,1)],[(0,1),(1,1),(1.05,0.825),(1.1,0.025),(1.25,-0.55),(1.35,-0.8),(1.5,-0.95),(2,-1)] )
T E quality on market share( [(0.75,0)-(1.25,2)],[(1.25,1.6),(1.2,1.4),(1.15,1.25),(1.1,1.15),(1.05,1.05),(1,1),(0.95,0.95),(0.9,0.85),(0.85,0.75),(0.8,0.6),(0.75,0.4)] )
ST memories lay offs = 1
desired production rate = desired throughput/perceived process yield
~ Hour/Day
~ Hour/Day
~ Dmnl/Day
~ Dmnl/Day
~ Worker
~ Hour/(Day*Worker)
~ Dmnl
~ Dmnl
~ Dmnl
~ Dmnl
~ Day
~ Day
~ Day
~ Day
~ Day
~ Hour/Day
ST forgetting lay offs=
1800
~ Day
~

days per year=
360
~ Day
~

traditional market share=
SMOOTH(market share,ST market share,INI traditional market share)
~ Dmnl
~

ST fluctuation=
14
~ Day
~

price level competitors= INITIAL(
INI price level*price)
~ €/Unit
~

production capacity=
min(machinery capacity,fraction of labor productivity for production)
~ Unit/Day
~

workers' training level= INTEG ( gains in training through hiring+training-loses in training from fluctuation and laying off -loses in training from forgetting, INI training level)
~ Hour
~

gains in training through hiring=
hiring**"averag. training new recruits"
~ Hour/Day
~

loses in training from fluctuation and laying off= "averag. training level"*(laying off+fluctuation)
~ Hour/Day
~

loses in training from forgetting= workers' training level/DT forgetting time training
~ Hour/Day
~
fraction of labor productivity for production=
work force*worker productivity*(1-training effort-fraction of training effort)
~ Unit/Day
~
customer order rate= market demand*market share
~ Unit/Day
~
WOM = E commitment on gains in commitment*(E management support+E perceived job security on commitment) + E improvement results on commitment)/3
~ Dmnl
~

ST market share = 360
~ Day
~
desired work force = desired gross production rate/Perceived Workers' Productivity/fraction of workers' productivity for training
~ Worker
~
change in workers' commitment = WOM/T communication
~ Dmnl/Day
~
training = intensity of training*work force*E training on gain in training
~ Hour/Day
~
Workerlücke = desired work force-work force
~ Worker
~
Perceived Workers' Productivity = SMOOTHi(worker productivity, ST workers' productivity,INI workers' productivity)
~ Unit/(Day*Worker)
~
T communication = 30
~ Day
~
INI traditional market share = 0.1
~ Dmnl
~
"max. averag. training level" = 40
~ Hour/Worker
~
management's training goal = GAME(0.5)
~ Dmnl
~
quality level = 1-fraction of defects in supply
~ Dmnl
~
"max. fraction working day for improvements" =
GAME(0.1)
~ Dmnl
~ |

"max. averag. experience level" =
100
~ Hour/Worker
~ |

management support =
desired management support per worker*work force*management's program commitment
~ Hour/Day
~ |

quality level competitors = INITIAL(
INI perceived quality level*quality level)
~ Dmnl
~ |

INI perceived process yield =
1-quality control*(likelihood of defects introduction-likelihood of defects introduction
*fraction of defects from suppliers
+fraction of defects from suppliers)
~ Dmnl
~ |

perceived process yield =
SMOOTHi( ratio net to gross production , ST process yield ,INI perceived process yield\)
~ Dmnl
~ |

INI finanzielle mittel =
1e+006
~ €
~ |

revenues =
net production rate*price
~ €/Day
~ |

ET processing time =
1080
~ Day
~ |

ET quality control =
1080
~ Day
~ |

ET worker productivity =
1080
~ Day
~ |

ET fraction of defects from suppliers =
1080
~ Day
AT price = 30
~ Day
~
desired margin = GAME(0.15)
~ Dmnl
~
KAPITALKOSTEN = 100
~ €
~
days per month = 30
~ Day/Month
~
deliveries = DELAY1(orders,DT deliveries)
~ Unit/Day
~
fraction of defects in supply = ZIDZ(undetected defects, net production rate)
~ Dmnl
~
market demand = 5000
~ Unit/Day
~
material costs = 10
~ €/Unit
~
INTERNER ZINSSATZ = 0.1
~ Dmnl
~
undetected defects = defects in production - defects elimination
~ Unit/Day
~
ST market = 60
~ Day
~
desired WIP level = desired production rate * processing time
~ Einheit
~
defects elimination = quality control * defects in production
~ Unit/Day
~ Unit

INI quality control = 0.9
~ Dmnl
~ Unit

WIP = INTEG ( feeding in processes - gross production rate, desired WIP level)
~ Unit
~ Unit

"max. quality control" = 1
~ Dmnl
~ Unit

"half-life time quality control" = 150
~ Day
~ Day

"max. worker productivity" = 12
~ Unit/(Worker*Day)
~ Unit/(Worker*Day)

INI worker productivity = 10
~ Unit/(Day*Worker)
~ Unit/(Day*Worker)

"half-life time worker productivity" = 350
~ Day
~ Day

INI fraction of defects from suppliers = 0.2
~ Dmnl
~ Dmnl

INI processing time = 2
~ Day
~ Day

"min. fraction of defects from suppliers" = 0
~ Dmnl
~ Dmnl

"min. machinery down time" = 0
~ Dmnl
~ Dmnl

"half-life time machinery down time" =
"half-life time processing time" =
400 ~ Day

"half-life time fraction of defects from suppliers" =
700 ~ Day

"half-life time likelihood of defects introduction" =
400 ~ Day

"min. likelihood of defects introduction" =
0 ~ Dmnl

inventory turnover =
inventory turnover WIP + inventory turnover materials
~ Day

INI likelihood of defects introduction =
0.2
~ Dmnl

feeding in processes =
min(desired gross production rate, materials/setup time)
~ Unit/Day

ET likelihood of defects introduction =
1080 ~ Day

orders =
MAX(0, desired gross production rate + correction materials)
~ Unit/Day

ratio net to gross production =
ZIDZ(net production rate, gross production rate)
~ Dmnl

desired materials =
desired gross production rate * desired materials coverage
~ Unit

inventory turnover materials =
ZIDZ(materials, feeding in processes)
~ Day
INI machinery down time = 0.1

setup time = 1

inventory turnover WIP = ZIDZ(WIP, net production rate)

ST perceived inventory turnover = 7

ST process yield = 7

defects in materials = INTEG (fraction of defects from suppliers * desired materials)

defects in WIP = INTEG (feeding in processes * (likelihood of defects introduction - likelihood of defects introduction * fraction of defects in materials + fraction of defects in materials) * processing time)

defects introduction due to processes = likelihood of defects introduction * (feeding in processes - defects feeding in processes)

delivering = net production rate

materials = INTEG (+ deliveries - feeding in processes, desired materials)

net production rate = gross production rate - defects elimination
backlog = INTEG (ordering-delivering, desired throughput time*ordering) 
~ Unit

desired materials coverage = 14 
~ Day

correction time materials = 14 
~ Day

desired gross production rate = MAX(0,desired production rate+correctionWIP) 
~ Unit/Day

correction materials = (desired materials - materials)/correction time materials 
~ Unit/Day

desired throughput = backlog/desired throughput time 
~ Unit/Day

desired throughput time = 2 
~ Day

correctionWIP = (desired WIP level-WIP)/correction time WIP 
~ Unit/Day

correction time WIP = 7 
~ Day

DT deliveries = 7 
~ Day

fraction of defects in WIP = defects in WIP/WIP 
~ Dmnl

defects in production = gross production rate*fraction of defects in WIP 
~ Unit/Day
defects from supplier =
    deliveries * fraction of defects from suppliers
    ~ Unit/Day

defects feeding in processes =
    fraction of defects in materials * feeding in processes
    ~ Unit/Day

fraction of defects in materials =
    defects in materials / materials
    ~ Dmnl