Administration factor[xRegion]=

DELAY1(Efficiency of Administration, c adm factor delay time)

Units: Dmnl

c 1 month=1

Units: Month

c 100 P=100

Units: Percent

c 12 months=12

Units: Month/Year

c adm factor delay time=6

Units: Dmnl

c average employment period=240

Units: Month

c confusion effect=0.1

Units: Dmnl

c confusion recover period=12

Units: Month

c delay time for officers=6

Units: Month

c integration sattle down period=36

Units: Month

c new Efficiency after integration=1.05

Units: 1/Month

c number of employees per company[CHWON]=

emplyee per company CHWON

c number of employees per company[CHJU]=

p employees per company CHJU

Units: Persons/EA

c optimum number of officers population nom[xRegion]=

D government employees[xRegion]

Units: Persons

c Regional green area change rate[xRegion]=0.01

Units: 1/Year

c starting time=2003

Units: Year

c sturation feeling density factor=0.1

Units: Dmnl

car delay time max vehicles[CHWON]=

IF THEN ELSE(integration yes no<1, p car delay time max vehicles[CHWON], p car delay time max vehicles[CHJU])

car delay time max vehicles[CHJU]=

p car delay time max vehicles[CHJU]

Units: Month

Changes in number of officers[xRegion]=

(optimu number of officers[xRegion] - Regional Number of Officers[xRegion]) / c delay time for officers * (1-integration yes no)

Units: Persons/Month

Companies change[xRegion]=

MAX(0, companies equi[xRegion] - Regional Number of Companies[xRegion]) / p company delay time

Units: EA/Month

companies equi[xRegion]=

Regional Population[xRegion] * companies per capita equi[xRegion]

Units: EA

companies per capita[xRegion]=

Regional Number of Companies[xRegion] / Regional Population[xRegion]

Units: EA/Person

Companies per capita change=

(p company sat per capita - Companies per Capita CHWON) / p company per capita delay time

Units: EA/(Month*Person)

Companies per Capita CHWON= INTEG (Companies per capita change,

i Companies per Capita)

Units: EA/Person

companies per capita equi[CHWON]=Companies per Capita CHWON

companies per capita equi[CHJU]=p company sat per capita

Units: EA/Person

D Budget[xRegion]

Units: kWons

D commercial zone[xRegion]

Units: km*km

D companies per capita[xRegion]:=

D number of companies[xRegion] / D Population[xRegion]

Units: EA/Person

D employee[xRegion]

Units: Persons

D government employees[xRegion]

Units: Persons

D green zone[xRegion]

Units: Persons

D housing supply rate[xRegion]

Units: Percents

D industrail zone[xRegion]

Units: km*km

D integrated area:=SUM(D Regional Area[xRegion!])

Units: km*km

D integrated paved road:=SUM(D Road[xRegion!])

Units: m

D integrated population:=SUM(D Population[xRegion!])

Units: Persons

d integration year=2010

Units: Year

D land value change[xRegion]

Units: Percent/Year

D local tax[xRegion]

Units: kWons

D medical institution[xRegion]

Units: EA

D number of companies[xRegion]

Units: EA

D park[xRegion]

Units: km*km

D planning area[xRegion]

Units: km*km

D Population[xRegion]

Units: Persons

D Regional Area[xRegion]

Units: km*km

D regional empoyee per company[xRegion]:=

D employee[xRegion] / D number of companies[xRegion]

Units: Persons/EA

D registered motor vehicles[xRegion]

Units: EA

D residential zone[xRegion]

Units: km*km

D Road[xRegion]

Units: m

D sewage distribution rate[xRegion]

Units: Percents

D supply rate of water[xRegion]

Units: Percent

D total number of companies:=SUM(D number of companies[xRegion!])

Units: EA

Efficiency change after integration=

IF THEN ELSE(integration yes no=1, 1, 0) *

(c new Efficiency after integration - Efficiency of Administration)/ c integration sattle down period

Units: 1/Month

Efficiency decrease due to integration=

IF THEN ELSE(Year>d integration year - 0.5 * TIME STEP/c 12 months :AND: Year <=d integration year + 0.5*TIME STEP/c 12 months, 1, 0) * c confusion effect / TIME STEP

Units: 1/Month

Efficiency Decreased due to Confusion= INTEG (Efficiency decrease due to integration - Efficiency recover from integration confusion, 0)

Units: Dmnl

Efficiency of Administration= INTEG

(Efficiency change after integration+ Efficiency recover from integration confusion-Efficiency decrease due to integration, 1)

Units: Dmnl

Efficiency recover from integration confusion=

Efficiency Decreased due to Confusion / c confusion recover period

Units: 1/Month

Employee per company= INTEG (Employee per company change, i Employee per company)

Units: Persons/EA

Employee per company change=(p employee per com CHWON - Employee per company) * (Employee per company - p empoyee per com base) / (p employee per com CHWON - p empoyee per com base

) * p empoyee diffusion coeff * IF THEN ELSE(Year<c starting time, 0, 1)

Units: Persons/(Month*EA)

emplyee per company CHWON=

IF THEN ELSE(Year<2007, D regional empoyee per company[CHWON], Employee per company)

Units: Persons/EA

farm area delay factor=

p utility ini farm area delay factor / local tax dmnl[CHWON]

Units: Dmnl

FINAL TIME = 240

Units: Month

The final time for the simulation.

i Companies per Capita= INITIAL(D companies per capita[CHWON] * p company CHWON ini adjustment)

Units: EA/Person

i Employee per company= INITIAL(D regional empoyee per company[CHWON] * 0.97)

Units: Persons/EA

i Land Value[xRegion]=100

Units: Percent

i local tax[xRegion]= INITIAL(D local tax[xRegion] * p local tax ini adjustment[xRegion])

Units: kWons

i Paved Road Region[xRegion]=D Road[xRegion] * p RD ini adjustment[xRegion]

Units: m

i Regional Area[xRegion]= INITIAL(D Regional Area[xRegion])

Units: km*km

i Regional Green Area[xRegion]=1000

Units: Persons

i Regional Number of Companies[xRegion]= INITIAL(

D number of companies[xRegion] * p company ini adjustment[xRegion])

Units: EA

i Regional Number of Employee[xRegion]= INITIAL(

Number of empoyees[xRegion])

Units: Persons

i Regional Number of Officers[xRegion]=

D government employees[xRegion]

Units: Persons

i Regional Population[xRegion]= INITIAL(

D Population[xRegion] * p pop ini adjustment[xRegion])

Units: Persons

i regional population density[xRegion]= INITIAL(

i Regional Population[xRegion] / i Regional Area[xRegion])

Units: Persons/(km*km)

i Regional Registered Vehicles[xRegion]= INITIAL(

D registered motor vehicles[xRegion] * p car ini adjustment[xRegion])

Units: EA

i Regional Supply Rate of Water[xRegion]= INITIAL(

D supply rate of water[xRegion] * p utility ini adjustment[xRegion])

Units: Percent

i Regional Supply Rate of Water dmnl[xRegion]=

i Regional Supply Rate of Water[xRegion]/ c 100 P

Units: Dmnl

INITIAL TIME = 0

Units: Month

The initial time for the simulation.

Integrated Number of Officers= INTEG (

new integrated officers+ SUM(trasfer to integrated offices[xRegion!])-Natural decrease rate, 0)

Units: Persons

integrated optimum number of officers=

IF THEN ELSE(Year<d integration year, SUM(optimu number of officers[xRegion!]),

SUM(c optimum number of officers population nom[xRegion!])

* (SUM(Regional Population[xRegion!]) / SUM(i Regional Population[xRegion!]))^p pop coeff)

Units: Persons

integrated Paved Road=SUM(Regional Paved Road[xRegion!])

Units: m

integrated pop increase rate=p pop increase rate

Units: 1/Year

integrated population=

SUM(Regional Population[xRegion!])

Units: Persons

integration yes no=

IF THEN ELSE(Year<d integration year, 0, 1)

Units: Dmnl

Land Value[xRegion]= INTEG (

Land value change[xRegion], i Land Value[xRegion])

Units: Percent

Land value change[xRegion]=

Land Value[xRegion] * land value increase rate monthly[xRegion]

Units: Percent/Month

land value change yearly[xRegion]=

Land value change[xRegion] * c 12 months

Units: Percent/Year

land value dmnl[xRegion]=

Land Value[xRegion] / i Land Value[xRegion]

Units: Dmnl

Land value increase rate[xRegion]=

p Land value increase rate[xRegion] * Regional attractiveness[xRegion]^p land value attractiveness coeff

Units: 1/Year

land value increase rate monthly[xRegion]=

LN(1+Land value increase rate[xRegion] / c 12 months * c 1 month) / c 1 month

Units: 1/Month

Local Tax[xRegion]=

i local tax[xRegion] * land value dmnl[xRegion] * Volume Index[xRegion]

Units: kWons

local tax dmnl[xRegion]=

Local Tax[xRegion] / i local tax[xRegion]

Units: Dmnl

Natural decrease rate=

Integrated Number of Officers / c average employment period

Units: Persons/Month

new integrated officers=

MAX(0, integrated optimum number of officers - Integrated Number of Officers + Natural decrease rate * TIME STEP) / c delay time for officers * IF THEN ELSE (Year>d integration year+ 0.5, 1, 0)

Units: Persons/Month

number of employee dmnl[xRegion]=

IF THEN ELSE(Year<2008, D employee[xRegion], Number of empoyees[xRegion]) / i Regional Number of Employee[xRegion]

Units: Dmnl

Number of empoyees[xRegion]=

Regional Number of Companies[xRegion] * c number of employees per company[

xRegion]

Units: Persons

optimu number of officers[xRegion]=

c optimum number of officers population nom[xRegion]

* (Regional Population[xRegion] / i Regional Population[xRegion])^p pop coeff

Units: Persons

other city premium=1.03

Units: Dmnl

p car delay time max vehicles[xRegion]=240, 63.8581

Units: Month

p car ini adjustment[xRegion]=0.979074, 0.990071

Units: Dmnl

p car max[xRegion]=2.62749, 1.50865

Units: Dmnl

p company CHWON ini adjustment=0.970621

Units: Dmnl

p company delay time=6

Units: Month

p company ini adjustment[xRegion]=0.754845, 0.999858

Units: Dmnl

p company per capita delay time=120

Units: Month

p company sat per capita=0.0644524

Units: EA/Person

p employee per com CHWON=7.54967

Units: Persons/EA

p employees per company CHJU=4.44524

Units: Persons/EA

p empoyee diffusion coeff=0.109193

Units: 1/Month

p empoyee per com base=6.29577

Units: Persons/EA

p land value attractiveness coeff=0.5

Units: Dmnl

p Land value increase rate[xRegion]=0.0460797, 0.0208424

Units: 1/Year

p local tax ini adjustment[xRegion]=0.901353, 0.822643

Units: Dmnl

p local tax volume diffusion factor[xRegion]=0.0179839, 0.0382031

Units: 1/Month

p local tax volume max index[xRegion]=5, 1.97658

Units: Dmnl

p pop coeff=0.3868

Units: Dmnl

p pop delay time=15.0067

Units: Month

p pop economic coeff=0

Units: Dmnl

p pop increase rate=0.0134374

Units: 1/Year

p pop ini adjustment[xRegion]=0.93883, 1.00259

Units: Dmnl

p pop road coeff=1.1363

Units: Dmnl

p pop saturation density=4577.65

Units: Persons/(km*km)

p pop utility coeff=0

Units: Dmnl

p RD delay time=1.00367

Units: Month

p RD ini adjustment[xRegion]=0.971749, 0.992562

Units: Dmnl

p RD interval city area=1.40438

Units: Year

p RD interval farm area=36

Units: Year

p RD pop coeff=0.153981

Units: Dmnl

p RD total potential road[xRegion]=765839, 970071

Units: m

p utility ini adjustment[xRegion]=1.00038, 0.996164

Units: Dmnl

p utility ini city delay time=5

Units: Year

p utility ini farm area delay factor=8.80985

Units: Dmnl

Paved Road change[xRegion]=Paved Road change rate month[xRegion]

Units: m/Month

Paved Road change rate[CHWON]=

Regional Potential Paved Road[CHWON] / IF THEN ELSE(Year<d integration year

, road interval farm area, p RD interval city area)

Paved Road change rate[CHJU]=

Regional Potential Paved Road[CHJU] / p RD interval city area

Units: m/Year

Paved Road change rate month[xRegion]=

Paved Road change rate[xRegion]/c 12 months

Units: m/Month

population density factor=

(p pop saturation density - regional population density[CHJU]) / p pop saturation density

Units: Dmnl

population economy factor[xRegion]=

population economy growth factor[xRegion]

Units: Dmnl

population economy growth factor[xRegion]=

number of employee dmnl[xRegion]^p pop economic coeff

Units: Dmnl

population quality factor[xRegion]=

(Regional Supply Rate of Water dmnl[xRegion] / i Regional Supply Rate of Water dmnl

[xRegion])^p pop utility coeff

Units: Dmnl

population road factor[xRegion]=

road dmnl[xRegion]^p pop road coeff

Units: Dmnl

Regional Area[xRegion]= INTEG (

Regional area change[xRegion],

i Regional Area[xRegion])

Units: km*km

Regional area change[xRegion]=0

Units: km*km/Month

Regional attractiveness[CHWON]=

population economy factor[CHWON]

* population quality factor[CHWON]

* population road factor[CHWON]

* IF THEN ELSE(integration yes no=1, other city premium, 1)

* Administration factor[CHWON]

Regional attractiveness[CHJU]=

population economy factor[CHJU] * population quality factor[CHJU] * population road factor

[CHJU] * other city premium

* Administration factor[CHJU]

Units: Dmnl

Regional Green Area[xRegion]= INTEG (

Regional green area change[xRegion],

i Regional Green Area[xRegion])

Units: Persons

Regional green area change[xRegion]=

Regional Green Area[xRegion] * Regional green area change rate month[xRegion]

Units: Persons/Month

Regional green area change rate month[xRegion]=

c Regional green area change rate[xRegion]/c 12 months

Units: 1/Month

Regional Number of Companies[xRegion]= INTEG (

Companies change[xRegion],

i Regional Number of Companies[xRegion])

Units: EA

Regional Number of Officers[xRegion]= INTEG (

Changes in number of officers[xRegion]-trasfer to integrated offices[xRegion], i Regional Number of Officers[xRegion])

Units: Persons

Regional Paved Road[xRegion]= INTEG (

Paved Road change[xRegion],i Paved Road Region[xRegion])

Units: m

Regional Population[xRegion]= INTEG (

Regional population change[xRegion], i Regional Population[xRegion])

Units: Persons

Regional population change[CHJU]=

(Regional population equi[CHJU] - Regional Population[CHJU]) / p pop delay time

* IF THEN ELSE(population density factor>c sturation feeling density factor

, 1, population density factor)

Regional population change[CHWON]=

(Regional population equi[CHWON] - Regional Population[CHWON]) / p pop delay time

+ (Regional population equi[CHJU] - Regional Population[CHJU]) / p pop delay time

* (1 - IF THEN ELSE(population density factor>c sturation feeling density factor

, 1, population density factor))

Units: Persons/Month

* IF THEN ELSE(population density factor>CCCC, 1, population

density factor)

regional population density[xRegion]=

Regional Population[xRegion] / Regional Area[xRegion]

Units: Persons/(km*km)

regional population dmnl[xRegion]=

regional population density[xRegion] / i regional population density[xRegion

]

Units: Dmnl

Regional population equi[xRegion]=

regional population nom[xRegion] * Regional attractiveness[xRegion]

Units: Persons

regional population nom[xRegion]= INTEG (

regional population nom[xRegion] * LN(1 + integrated pop increase rate / c 12 months

* c 1 month) / c 1 month,

i Regional Population[xRegion])

Units: Persons

Regional Potential Paved Road[xRegion]= INTEG (

-Paved Road change[xRegion] + (total required paved road[xRegion] - Regional Potential Paved Road

[xRegion] - Regional Paved Road

[xRegion]) / p RD delay time,

p RD total potential road[xRegion]- i Paved Road Region[xRegion])

Units: m

Regional Registered Vehicles[xRegion]=

i Regional Registered Vehicles[xRegion] * Regional Population[xRegion] / i Regional Population

[xRegion] * Regional Registered Vehicles dmnl[xRegion]

Units: EA

Regional Registered Vehicles dmnl[xRegion]= INTEG (

Registered car dmnl change[xRegion], 1)

Units: Dmnl

Regional supply rate change[xRegion]=

(c 100 P - Regional Supply Rate of Water[xRegion]) / utility delay time[xRegion]

Units: Percent/Month

Regional Supply Rate of Water[xRegion]= INTEG (

Regional supply rate change[xRegion], i Regional Supply Rate of Water[xRegion])

Units: Percent

Regional Supply Rate of Water dmnl[xRegion]=

IF THEN ELSE(Year<2008, D supply rate of water[xRegion],

Regional Supply Rate of Water[xRegion]) / c 100 P

Units: Dmnl

Registered car dmnl change[xRegion]=

(p car max[xRegion] - Regional Registered Vehicles dmnl[xRegion]) / car delay time max vehicles

[xRegion]

Units: 1/Month

road dmnl[xRegion]=

IF THEN ELSE(Year<2008, D Road[xRegion], Regional Paved Road[xRegion]) /

i Paved Road Region

[xRegion]

Units: Dmnl

road interval farm area=p RD interval farm area / local tax dmnl[CHWON]

Units: Year

SAVEPER =

TIME STEP

Units: Month

The frequency with which output is stored.

TIME STEP = 0.125

Units: Month

The time step for the simulation.

total Number of Companies=

SUM(Regional Number of Companies[xRegion!])

Units: EA

total number of officers=

SUM(Regional Number of Officers[xRegion!]) + Integrated Number of Officers

Units: Persons

total required paved road[xRegion]=

p RD total potential road[xRegion] * regional population dmnl[xRegion]^p RD pop coeff

Units: m

trasfer to integrated offices[xRegion]=

Regional Number of Officers[xRegion] / TIME STEP * integration yes no

Units: Persons/Month

utility delay time[CHWON]=

IF THEN ELSE(integration yes no=1, p utility ini city delay time, p utility ini city delay time

* farm area delay factor) * c 12 months

utility delay time[CHJU]=

p utility ini city delay time * c 12 months

Units: Month

Volume Index[xRegion]= INTEG (Volume index change[xRegion], 1)

Units: Dmnl

Volume index change[xRegion]=

(p local tax volume max index[xRegion] - Volume Index[xRegion]) * Volume Index

[xRegion] / p local tax volume max index[xRegion] * p local tax volume diffusion factor[xRegion]

Units: 1/Month

xRegion: CHWON,CHJU

Year=TIME BASE(2000, 0.0833333)

Units: Year