

## Online Appendix: Equations and Parameters of the SD Model

- (01) Base Development Productivity=1  
Units: Application/Month/Developer
- (02) Commitment from IT Managers=Normative Commitment+Commitment from Perceived Benefits  
Units: Dmnl
- (03) Commitment from Perceived Benefits=Perceived Benefits of SOA \* 1  
Units: Dmnl
- (04) Cycle Time of System REQ Backlog=1  
Units: Month  
The time (number of months) within which the system requirement backlog needs to be developed clearly
- (05) Delivery Rate Gap=MAX( 0, 1-System Delivery Rate/Desired Delivery Rate )  
Units: Dmnl
- (06) Desired Delivery Rate=IT System REQ Backlog/Cycle Time of System REQ Backlog  
Units: Application/Month  
The system delivery rate that is desired to complete the system req backlog within the cycle time
- (07) Desired IS Agility=1  
Units: Interoperability Unit
- (08) Developer Headcount=Funding Rate/Developer Wage  
Units: Developer
- (09) Developer Wage=100  
Units: Dollar/Month/Developer
- (10) Development Productivity=Base Development Productivity\*(1+Effectiveness of SOA)  
Units: Application/(Month\*Developer)
- (11) Duration=10  
Units: Month
- (12) Effectiveness of SOA=  
Table for Effectiveness("Knowledge of Using Service-Oriented Systems"\*"Proportion of Service-Oriented Systems")  
Units: Dmnl
- (13) Erosion Rate of Using Knowledge= 0.1  
Units: Dmnl/Month
- (14) FINAL TIME = 100  
Units: Month  
The final time for the simulation.
- (15) Fraction of Time Spent on Functional REQ=  
Table for Pressure(MIN( 10 , Pressure to Deliver on Schedule/Pressure to Implement SOA))  
Units: Dmnl
- (16) Fraction of Time Spent on SOA REQ=1-Fraction of Time Spent on Functional REQ  
Units: Dmnl
- (17) Funding Rate=Magnitude\*(Input\*0+1)  
Units: Dollar/Month
- (18) INITIAL TIME = 0  
Units: Month  
The initial time for the simulation.
- (19) Input=1+STEP(Step Height,Step Time)+  
(Pulse Quantity/Pulse Duration)\*PULSE(Pulse Time,Pulse Duration)+

RAMP(Ramp Slope,Ramp Start Time,Ramp End Time)+  
Sine Amplitude\*SIN(2\*3.14159\*Time/Sine Period)

Units: Dimensionless

Input is a dimensionless variable which provides a variety of test input patterns, including a step, pulse, sine wave, and random noise.

- (20) Installed IT Systems= INTEG (System Delivery Rate-System Erosion Rate,100)  
Units: Application
- (21) IS Agility=Table for IS Agility("Proportion of Service-Oriented Systems")  
Units: Interoperability Unit
- (22) IS Agility Gap=1-IS Agility/Desired IS Agility  
Units: Dmnl
- (23) IT System REQ Backlog= INTEG ( REQ Introduction Rate-System Delivery Rate,1)  
Units: Application  
How many application systems that are in the stock and need to be developed
- (24) "Knowledgeof Using Service-Oriented Systems"= INTEG ( Learning Rate of Using Knowledge-Erosion Rate of Using Knowledge, 0)  
Units: Dmnl
- (25) Learning Rate of Using Knowledge=  
(10-"Knowledgeof Using Service-Oriented Systems")/Learning Time of Using Knowledge  
/Table for Learning("Proportion of Service-Oriented Systems"\*Perceived Benefits of SOA)  
Units: Dmnl/Month  
Max of knowledge is 10;
- (26) Learning Time of Using Knowledge=12  
Units: Month
- (27) Magnitude=1000  
Units: Dollar/Month
- (28) Normative Commitment= 0.8 - STEP( 0.8, Duration)  
Units: Dmnl
- (29) Perceived Benefits of SOA=Effectiveness of SOA \* 1  
Units: Dmnl
- (30) Pressure to Deliver on Schedule= DELAY INFORMATION ( Table for Delivery Rate Gap(0.5\*Delivery Rate Gap), 1, 0)  
Units: Dmnl  
Incorrect comment: I assume it is a first-order delay relationship between the Gap and Pressure
- (31) Pressure to Implement SOA=Table for IS Agility Gap(IS Agility Gap\*Commitment from IT Managers)  
Units: Dmnl
- (32) "Proportion of Service-Oriented Systems"="Service-Oriented Systems"/Installed IT Systems  
Units: Dmnl
- (33) Pulse Duration=1  
Units: Month  
Duration of pulse input. Set to Time Step for an impulse.
- (34) Pulse Quantity=0  
Units: Dimensionless\*Month  
The quantity to be injected to customer orders, as a fraction of the base value of Input. For example, to pulse in a quantity equal to 50% of the current value of input, set to .50.
- (35) Pulse Time=0

- Units: Month  
Time at which the pulse in Input occurs.
- (36) Ramp End Time=1e+009  
Units: Month  
End time for the ramp input.
- (37) Ramp Slope=0  
Units: 1/Month  
Slope of the ramp input, as a fraction of the base value (per year).
- (38) Ramp Start Time=0  
Units: Month  
Start time for the ramp input.
- (39) REQ Introduction Rate=12  
Units: Application/Month  
How many application systems are introduced to be developed per month
- (40) SAVEPER = TIME STEP  
Units: Month [0,?]  
The frequency with which output is stored.
- (41) "Service-Oriented System Delivery Rate"=2\*Fraction of Time Spent on SOA  
REQ\*System Delivery Rate  
Units: Application/Month
- (42) "Service-Oriented System Erosion Rate"=0.5  
Units: Application/Month
- (43) "Service-Oriented Systems"= INTEG (  
"Service-Oriented System Delivery Rate"-"Service-Oriented System Erosion  
Rate",0)  
Units: Application
- (44) Sine Amplitude= 1  
Units: Dimensionless  
Amplitude of sine wave in customer orders (fraction of mean).
- (45) Sine Period=12  
Units: Month  
Period of sine wave in customer demand. Set initially to 4 years to simulate the business  
cycle
- (46) Step Height=0  
Units: Dimensionless  
Height of step input to customer orders, as fraction of initial value.
- (47) Step Time=50  
Units: Month  
Time for the step input.
- (48) System Delivery Rate=  
Fraction of Time Spent on Functional REQ\*Development  
Productivity\*Developer Headcount  
Units: Application/Month
- (49) System Erosion Rate=1  
Units: Application/Month
- (50) Table for Delivery Rate Gap(  
[(0,0.2)-(1,1)],(0,0.2),(0.0550459,0.407895),(0.103976,0.513158),(0.16208  
,0.622807),(0.229358,0.701754),(0.314985,0.763158),(0.492355,0.868421),(0.718654  
,0.951754),(0.87156,0.991228),(0.941896,1),(0.957187,1),(0.990826,1))  
Units: Dmnl
- (51) Table for Effectiveness(

[(0,0)-(10,1)],(0.0611621,0.00438596),(1.46789,0.0131579),(2.11009,0.0263158),  
(2.56881,0.0614035),(3.02752,0.131579),(4.1896,0.29386),(5.04587,0.5),(5.41284,  
.0.622807),(6.08563,0.767544),(6.57492,0.850877),(7.43119,0.942982),(8.34862,  
.0.969298),(9.38838,0.986842),(9.87768,1))

Units: Dmnl

- (52) Table for IS Agility(  
[(0,0.2)-(1,1)],(0,0.2),(0.088685,0.210526),(0.171254,0.217544),(0.223242,  
.0.231579),(0.29052,0.259649),(0.33945,0.305263),(0.376147,0.357895),(0.415902,  
.0.431579),(0.446483,0.526316),(0.477064,0.607018),(0.507645,0.677193),(0.529052,  
.0.729825),(0.574924,0.814035),(0.66055,0.912281),(0.712538,0.954386),(0.807339,  
.0.982456),(0.908257,0.992982),(0.972477,1.00351))

Units: Interoperability Unit

- (53) Table for IS Agility Gap(  
[(0,0)-(1,1)],(0.00611621,0.1),(0.0917431,0.346491),(0.198777,0.583333),(  
0.345566,0.75),(0.492355,0.868421),(0.718654,0.951754),(0.87156,0.991228),  
(0.941896,1),(0.957187,1),(0.990826,1))

Units: Dmnl

- (54) Table for Learning(  
[(0,0.5)-(1,1)],(0.0030581,0.995614),(0.0764526,0.993421),(0.137615,0.989035  
,(0.214067,0.971491),(0.281346,0.934211),(0.345566,0.888158),(0.415902,0.813596  
,(0.477064,0.723684),(0.522936,0.642544),(0.59633,0.587719),(0.672783,0.557018  
,(0.752294,0.530702),(0.82263,0.519737),(0.938838,0.508772),(0.990826,0.506579  
)

Units: Dmnl

- (55) Table for Pressure(  
[(0,0.5)-(10,1)],(0,0.5),(1,0.506579),(1.65138,0.510965),(2.32416,0.528509  
,(2.9052,0.550439),(4.43425,0.638158),(5.04587,0.703947),(5.9633,0.820175  
,(6.39144,0.872807),(7.00306,0.916667),(7.40061,0.942982),(7.88991,0.967105  
,(8.40979,0.980263),(8.8685,0.991228),(9.08257,0.995614),(9.20489,0.997807  
,(9.5,1))

Units: Dmnl

- (56) TIME STEP = 1

Units: Month [0,?]

The time step for the simulation.