Equation 1 : Leaky integrator neural dynamic.

$$v_m(k) = f(v_m(k-1) + v_t(k)) - l$$

$v_m(k)$	= membrane potential at cycle k
$v_t(k)$	= sum of the synaptic input as calculated in eq.2
f	= ascending exponential function set between 0 and threshold (set as 65)
l	= leak value (set as 1)

This function (eq. 2) represents a nonlinear potential variation simulating an excitatory or inhibitory postsynaptic potential (PSP).

Equation 2 : General function describing numerically a postsynaptic potential curve.

$$f(t) = \begin{cases} ge^{-t/\pi} & if t \leq tMax \\ 0 & if t > tMax \end{cases}$$

g	= maximum amplitude (i.e. 20)
π	= tau (i.e. 8)
t	= time since spike (cycle)
$tMax$	= maximum duration of a PSP (i.e. 15)

Equation 3 : Adapted STDP function.

$$\Delta w = b * \alpha_{t_{post}-t_{pre}} e^{\frac{t_{post}-t_{pre}}{\pi}}$$

Δw	= synaptic weight change
$\alpha_{t_{post}-t_{pre}}$	= 1 or -1, depending on the sign of $t_{post} - t_{pre}$
π	= time constant
b	= bias factor (1.0)

STDP coefficients for Δw :

Effect duration = 20000 cycles
Max. synaptic change in one paired spike = 100%
Max. global synaptic change = 40-300%
Max. STDP time window = 150 cycles

Equation 4 : Calculating the number of neurons for each level (primary, secondary or tertiary) for the n-bit XOR problem.

$$y = 2^k \binom{n}{k}$$

y	= number of neurons
k	= level
n	= number of bit (inputs)